

Role of Professional Associations in Agricultural Innovation Systems

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Executive Summary

Professional Associations (PAs) refer to a formal organization of professionals or a group of professionals, which are practitioners of a given profession united together by mutual consent to deliberate, determine and act jointly for a common purpose. Professional Associations (PAs) can play a significant role in shaping agricultural policy as well as in re-directing their scientific knowledge to more socially relevant problems. Individual members of the PAs as well as the PAs themselves have the potential to play such a role. PAs in agricultural sciences are predominantly part of R&D system and are positioned uniquely to use their voluntary mandate and organizational flexibility to address broader goals relevant to the society. PAs as of now are little recognized as “Innovation Systems Actors” in the “Agricultural Innovation System”. Agricultural innovation system(AIS) refers to the interlinked and learning network of organizations and individuals together with institutions and policies that affect their innovative behavior. Professional Associations (PAs) are an important component of R&D system because they provide an opportunity outside the public system and assume a role, which is complementary to well-defined and well structured role of the public R&D. They are created by a voluntary group, which shares a common concern and shared intent to address them. PAs are different from other organizations in the R&D as their central concern about furthering the interests of the profession and its social relevance and are not tied to any patron (State/private/civil/legal entity), and can legitimately reflect upon the status/evolution of the profession in order to strengthen its professional identity and future. PAs have been identified as “innovation System Actors” and explored for improving understanding of their roles and capacities in the AIS to play a dual role of serving the cause of expertise on the one hand and innovation in society on the other hand. *This study explored PAs for their role as important “innovation system actors” the first entry points of the ITS program initiative for improving understanding of their roles and capacities in two selected agricultural innovation systems in India.*

Overall objective of the research was to study the role of PAs as a key link between knowledge and society and to look for processes that would enable more effective linkages in the AIS. The study looks at PAs in two innovation systems in the agriculture sector - one relatively new and emerging, the Organic Agriculture Innovation System (OAIS) and one fairly well established, the Hybrid seeds innovation System (HSIS). The two sectors had all the criteria's that could capture elements of the dynamic agricultural context of the country. PAs present in both the formal R&D system and outside it (informal) were surveyed.

An innovation system framework has been used for the analysis. Desk research and interviews with the key informants/specialists belonging to the two innovation systems were explored to understand various actors, their roles and institutions, their linkages or relationship among each other through evolution of the two innovation systems in India. Among these actors: PAs were located as “innovation system actors” and three PAs each were selected outside the formal R&D system in the innovation systems explored, while, three PAs from the formal R&D system belonging to the two agricultural innovations

system were explored for the analysis. The study used four features of innovation systems as the main analytical tools to understand the presence, interactions and roles of PAs in enabling OA innovation. These four innovation system features are: *Presence and interaction of several organizations/actors with bringing of different sources of knowledge, Focus is on both technological as well as institutional change/innovations, Evidence of learning and behavioural changes & Creating or enabling policy and institutional environment.*

PAs in OAIS revealed that their activities help farmers mostly with local organic production. Interactions are need based & diverse with stakeholders ranging from farmers, input producers, traders, retailers, legal and certification organizations. These PAs facilitate and provide a platform to share and learn. They also have linkages with other similar organizations in the OAIS. They help farmers with technological innovations as well as institutional innovations; for example, technological innovations related to production of organic inputs, training programmes, location specific packages of practices, while institutional innovations in response to high certification costs. There is a mixture of both rigidity and evidence of learning and behavioral changes. They are able to create enabling policy and institutional environment by facilitating certification processes, capacity building programmes and pushing organic policy in the states. *However, they are disconnected with the expertise that generates technologies (research system), often so they are unable to persuade them to take up technological problems.*

Diagnosing PAs Capacities in the HSIS revealed that interactions were not very diverse and these PAs mostly form a link between the Public Sector Organizations (earlier the only source of breeder seeds) and private sectors seed companies get resources material for multiplication and sale to farmers with little interactions with farmers, research system/PAs in Formal R&D. So they mostly focused on technological innovations. Interactions were mostly through seminars/workshops to influence industry agenda. Evidence of learning and behavioural change is evident from the recent institutional innovation among these PAs that they recognize the need for collective professional voice in the industry and four of these PAs have joined together to form a single professional association to advocate favourable policies for the hybrid seed sector.

Contrary to the above PAs, formal R&D based PAs belonging to the two AISs show very little innovation system features. Their learning linkages are either non-existent or minimal. These PAs work in strict disciplinary modes with modest integration with other disciplines. They neither have any linkages with other PAs/ or common projects /activities linking various PAs. Nor are they sought after for services as specialists and their participation at all levels of S&T activities from research to policy making is negligible. A sense of isolation prevails within these professional groups of researchers, scientific elites and frequent professional meetings, activities confined to holding annual meetings. *These PAs have hardly played any role in the institutional reform in the agricultural sciences or towards the dynamic role that science can play to the society as one of the components in wider innovation systems.* They are hardly mentioned in the wider AIS.

The differences in the nature of PAs associated with the two AISs owe mainly to the diverse stages of evolution of the respective sectors, different contexts, and interactions with the formal S&T. The attempted comparison was not aimed at bringing out differences, but to get an overall picture of their roles and capacities. It was useful to highlight the diversity of contexts in which PAs operate and ways in which their roles can be strengthened.

Major findings that confirm the role of PAs in enabling innovations revealed that *PAs are important actors in bringing together other socially embedded actors* in both the innovation systems explored, they played *important role in shaping other actors* in the innovation system and have played an important role to *enable learning within the PAs as well as among the actors* in the innovation system. They have also been able to create an *enabling policy and institutional environment for their respective sub-sectors* and innovation systems. PAs, which have largely not found much place in the literature, are playing an important role of facilitating communication and interactions among various actors with different technological & social competencies. By doing so they enable innovation. In these two cases analyzed here, they represent a link between the public sector R&D and private sector as well as the Civil Society Organizations.

PAs may not be the dominant “innovation system actors” in the innovation systems but there are very many positive lessons to be learned from some of the institutional changes they have been able to push and introduce in each of the AISs. They also bring flexibilities related to funding, human resources or in the ways to organize their working. PAs thus present cases of both technological and institutional changes – the former because of their opportunity to draw from their own scientific expertise, the latter because they find ways of enabling new rules, certification norms, procedures, practices etc. that can help the technology as well as the sector as whole.

Yet policy making in general, and agricultural policy in particular have not recognized the potential role of the PAs. All policy efforts go into strengthening or funding agricultural R&D organizations and extension. The study proved its hypothesis, viz., and the fact that PAs do play an important role in agricultural innovation. It did so by demonstrating and analyzing how the PAs play a role in improving the capacity and inter-linkages among actors (organizations and individuals) in both the hybrid seeds and organic agriculture sectors. *However, comparison and findings from the exploration of the role of PAs in the two AISs revealed that PAs are important actors in the innovation system but their roles have not changed in the changing context.* This change will happen only when their professionalism is recognized in the innovation system. The professionalization of these PAs could be increased by increasing their visibility and recognition by the State, but not compromising with their flexibility and voluntary nature. The study gives specific recommendations for PAs by the State and Industry to strengthen S&T and its relevance to enhance the positive role that “PAs” can play in agricultural innovation. These PAs can, if supported appropriately, now play a major role in institutional reform in the agricultural sciences. They can orient the agricultural sciences towards the dynamic role that science can play as one of the components in wider innovation systems.

Acronyms and Abbreviations

AICBA - All India Crop Biotechnology Association
AIOBFA- All India Organic and biodynamic farming Association
AIS-Agricultural Innovations System
APEDA- Agricultural and Processed Food Export Development Authority
APOF - Association for Promotion of Organic Farming
ASI- Association of Seed Industry
CAPART- Council for Advancement of People's Action and Rural Technology
COF- Centre for Organic Farming
DST-Department of Science and Technology
FAO-Food and Agriculture Organization
HS- Hybrid Seeds
HSIS-Hybrid Seeds Innovation System
IBRD- International Bank for Reconstruction and Development of the World Bank
ICAR-Indian Council for Agricultural Research
ICRISAT-International Crops Research Institute for the Semi-Arid Tropics
ICS-Internal Control System
IFOAM- International Federation of Organic Agriculture Movements
INORA- Institute of Natural Organic Agriculture
IPS- Innovation, Policy and Science
ISIA- Indian Seed Industry Association
ISPBG- Indian Society for Plant Breeding and Genetics
ISSS Indian Society for Soil Sciences
ISST-Indian Society for Seed Technology
ITS- Innovation, Technology and Society
MOFF -Maharashtra Organic Farming Federation
NARS-National Agricultural Research System
NCOF-National Centre for Organic Farming
NGO- Non Governmental Organization
NOCA- Natural Organic Certification Association
OAIS -Organic Agriculture Innovation System
OA-Organic Agriculture
OASIS - Organic Agriculture Society for Integrated services
OFAI- Organic farming Association of India
PAs-Professional Associations
PGS-Participatory Guarantee System
POPs- Packages of Practices
SAI - Seed Association of India
SAUs-State Agricultural Universities
UCOB -Uttaranchal Organic Commodity Board

Role of Professional Associations in Agricultural Innovation Systems

1. Introduction

Agricultural innovation system is different from the Agricultural research system as the later generally relates to a group of scientific organizations, which is involved in the creation of scientific and technological knowledge related to agriculture. Agricultural innovation systems (AIS) refers to all the actors involved in the production, diffusion, adaptation and most importantly the use of new knowledge in the agricultural sector. There is a demand for a shift in the approach to knowledge in agriculture, from conventional R&D to agricultural innovation. The concept has been used as a policy tool that can guide the thinking and analysis of how innovation can be nurtured and how socio-economic change can be accelerated (Hall *et al.*, 2004). The concept of AIS focuses on (1) strengthening the broad spectrum of science and technology activity of organizations (2) on enterprises and the individuals that demand and supply knowledge and technologies and enabling appropriate rules and mechanisms by which research and non-research actors interact. Professional Associations (PAs) are part of R&D system but are positioned uniquely to use the flexibility, and are not bound by the organizational mandates to play much broader goals relevant to the society. PAs have been identified as “Innovation System Actors” and explored for improving understanding of their roles and capacities in the AIS to play a dual role of serving the cause of expertise on the one hand and innovation in society on the other hand.

The focus of this study is on two **main research questions**:

1. *What is the role being played by the Professional Associations in India in Agricultural Innovation System?*
2. *What are the opportunities to leverage their current role and identify the strategies for intervention for Professional Associations to play a more effective role in Agricultural Innovation System?*

PAs as of now are little recognized as innovation systems actors in the agricultural innovation systems. Exploring discipline based PAs located in the natural resources management innovations system revealed their limited engagement with the key professional and social issues that confront the discipline (soil sciences) in which they are located (Raina *et al.*, 2006, Raina and Sangar, 2006). This study in continuation of earlier endeavor on PAs where they have been explored for their role in science and technology policies and impact and inclusions, the two major entry points of the Innovation,

Technology and Society program initiative¹, of IDRC (ITS prospectus (2006-11), 2006-2007). This study explores PAs for their role as important innovation system actors the first entry points of the ITS program initiative for improving understanding of this innovation system actors roles and capacities in agricultural innovations system in India. The study will recommend few options for policy and action which will (a) enhance the role of PAs in agricultural innovation systems (b) promote excellence in science with social responsibility.

1.1. Professional Associations in Agricultural Innovations System

Professional Associations (PAs) refer to a formal organization of professionals or a group of professionals, which are practitioners of a given profession united together by mutual consent to deliberate, determine and act jointly for a common purpose. This is the case whether the PA is that of dentists, cardiologists, pharmacologists, soil scientists, plant breeders, lawyers, economists or other professions. PAs in agricultural innovations system have emerged through voluntary action largely with a view to establish identity of increasingly specialized groups to promote the subject/discipline/ in which these groups have a common interest. The PAs are largely self-supported and carry out their activities with funds raised through subscription/membership fee, voluntary contribution of time by office bearers etc. They are also often eligible to receive small grants which enable them organize minimal activities. The members of PAs are largely active /retired employees of research institutes, university departments or students, while their participation in societal activities is voluntary and driven by desire to promote professional interest and personal recognition. PAs are important in the transformation of highly institutionalized fields by giving its members an identity, consistent space to interact, and a common understanding of conduct. They also act as a forum for interactions with other stakeholders (Greenwood *et al.*, 2002).

Major issues or challenges in the agricultural sciences/technologies adopted/generated are often directed to scientists as experts in their respective organizations, disciplines or departments. Often organizational mandates (ranging from policy directives to vision/mission statements), disciplinary construct or limits, regional or location-specific issues constrain these changes demanded from science for sustainable agriculture.

PAs are an important component of R&D system because they provide as opportunity outside the public system and assume a role, which is complementary to well –defined and well structured role of the public R&D. PAs are different from other organizations in the R&D as their central concern about furthering the interests of the profession and its social relevance and are not tied to any patron (State/private/civil/legal entity), and can legitimately reflect upon the status/evolution of the profession in order to strengthen its

¹ ITS Public website www.idrc.ca/its

professional identity and future. Scientists which are part of PAs and have an opinion about the sciences they work with, the societies and ecosystems they inhabit, which are not colored by the above organizational and disciplinary constraints. PAs ability to articulation of problems, convening power and public/stakeholder participation **can encourage innovations by linking and sharing needed expertise and resources**. Some of the PAs have played a role as the dissemination of knowledge needed for innovations to practitioners in Industry, for example, PAs related to pharmaceuticals, but some of the PAs related to the discipline geared up to look at issues beyond the industrial aspects and look for issues related to pharmacy education, quality improvement of the curriculum, a more useful role in health care of country etc. This voluntary nature of PAs gives them the inherent convening power and drive, a unique position and flexibility to play a key role in the innovations to play much broader goals relevant to the society. **This study explores the role and capacities of PAs in two important Agricultural Innovation Systems-Organic Agriculture Innovation System (OAIS) and Hybrid Seeds Innovation System (HSIS).**

The primary features that have been used to identify and select PAs for this study are:

- PA formed by virtue of a group of professionals who came together for a common cause
- They possess the professional authority on the subject or the professions they belong to
- PA's possess essential feature of professions such as professional expertise, credentialism, and Authority (Burrage, M., Torstendahl, R. (Eds.) (1990)
- PA organized to help further the cause and on non-profit basis
- PA is a legal entity, mostly registered under 'The Societies Registration Act, 1860' or The Societies registration Act of a particular State
- Members of the governing body meet annually to review/further the cause of the PA
- New Members are added/removed based on the need of the endeavor
- Mode of selection of Governing body members is democratic (voting by members) or by consensus
- Funds for its activities/staff are generated mostly through membership fees, externally funded projects, or from the sponsors of seminars/meetings/workshops organized by the PA

1.2. Justification for the study

Professional Associations are crucial and relevant actors in an AIS but little attention has been paid to them as one of the key actors in relation to other actors in the AIS for development. There has been a proliferation of PAs, their journals, and meetings/conferences in the AIS in India. Currently these PAs in agricultural sciences have not been able to contribute significantly to the changing scenarios and broader development goals of sustainable agriculture (Sangar, *et al.*, 2005). PAs have a large and a changing role to play than they have played in the past in meeting the emerging challenges of

agricultural innovation system. PAs through individual members and as professional bodies can play a significant role in shaping agricultural policy as well as in re-orienting the content of their sciences to more socially relevant problems. The involvement of PAs can institutionally reform the existing discipline based, commodity oriented, and linear approach to a learning and partnership based innovation systems approach (Raina *et al.*, 2006). The social sciences now have ample evidence to prove that technology alone is insufficient to make any impact on yield or ultimately on poverty reduction. Technology can make an impact on poverty reduction or ecological sustainability or sustained yield enhancement, only when there are appropriate partnerships and other institutional arrangements that encourage actors to confront complex problems and contexts, build and sustain self-reflective evaluation cultures and recognize/change the different cultures of science in different organizations (Raina, 2001). PAs as key actors in the AIS could play a crucial role of facilitating continuous evolutionary cycles of learning and innovation, by maintaining a continuous interaction with diverse research and non-research actors. Despite evidence that PAs do play an active role in the interactions between science and society, the innovation systems literature has largely ignored the role of these crucial actors in agricultural sciences in India. This research study would help improve understanding of the innovation system roles played by the PAs and enable the capacity building and interactions within as well as between other actors involved in AISs. **PAs have rarely been seen as important actors in the AIS, this study aims to do this by looking at PAs as “innovation systems actors” in the selected two agricultural innovation systems.** This research study focuses on the role of PAs as key innovation system actors in the Organic Agriculture Innovation System (OAIS) and Hybrid Seeds Innovation System (HSIS). The only difference between the PAs we know of in science and these PAs, which are build into the broader AIS, are that they are located outside the research system (ICAR). Although, these have been created by the professionals but they do not have features of expertise and credentialism, to confer professional authority and greater autonomy needed to strengthen professionalization of agricultural research (Raina, 1999).

This might be considered a limitation of the study in the strict conceptual sense of the term ‘professional’ association. These PAs were all founded by scientists. They have members who are non-scientists too – but members who are sworn into the OA or hybrid seed fraternity. But the criteria of expertise (some knowledge about OA or hybrid seeds – scientific, economic, etc.), credentialism (besides the conventional ‘degree’ which gives members entry into the PA, here they look for commitment to the agenda of the PA- to promote OA or widespread acceptance and use of hybrid seeds) and authority (mostly hailing from the research system with a technological background) are not essential features² of the PAs explored in the strict sense.

² All occupations that have achieved the status of professions are characterized by three essential features : expertise, credentialism, and autonomy (Freison, 1984).

1.3. Objectives

These research questions will be explored through an **overall objective**

To study the role of PAs as a key link between knowledge and society and to look for processes that would enable more effective linkages in the two AISs.

This overall objective would understand and analyze

- (a) PAs as actors, their evolution and institutions that govern their growth /existence in AISs
- (b) the nature of participation and linkages of the PAs with other actors in two selected AISs
- (c) the role that these PAs play in strengthening agricultural innovation
- (d) the ways in which they promote the interests of agricultural sciences, the feedback, linkage and learning mechanisms that these PAs employ to understand the impact of their R&D on poverty, food security, environmental sustainability.

Expected outcomes of research

- (i) enable more effective linkages between major components of the ST&I spectrum in agriculture – the public sector and private sector R&D, policy making bodies and development departments, private industry, the farming community, and several other actors including equipment manufacturers, local level Governments (panchayats, District Development Committees, etc.), women's organizations, etc., and
- (ii) explore whether PAs have a unique/niche role to play in the agricultural innovations system and whether opportunities exist to leverage that unique role.
- (iii) Identifying effective strategies points for the capacity building of PAs for selected agricultural innovations

2. Analytical framework

An Innovation system framework has been used for explore the role of PAs in two agricultural innovation systems. An innovation system refers to a network of organizations or actors, together with the institutions and policies that affect their, innovative behaviour. This innovative behaviour brings (generates, develops diffuses/adapts and ensures the utilization of) new products, new processes and new ways of working or form of organization into the economy /society. The innovation systems concept embraces not only the science suppliers but also the totality and interaction of actors involved in innovation. It extends beyond the creation of knowledge to encompass the factors affecting demand for and the use of knowledge in novel and useful ways (IBRD, 2006). The innovation systems concept offers a new framework for analyzing the roles of science and technology and their interaction with other actors to generate good and services.

AIS concept is slowly being applied to developing –country issues in agriculture and the rural sector. It differs from the usual way of visualizing agricultural research through Agricultural Research system which refers to the group of scientific organizations involved with the creation of scientific and technological knowledge related to agriculture. AIS in contrast explores all the actors involved in the production, diffusion, adaptation and most importantly use of new knowledge in the agricultural sector. It aims to highlight the essential characterizes of an AIS, and in the same time draw attention to the institutional changes needed for agricultural research organizations to locate themselves better in the wider innovation system in which they participate. AIS in these studies have been presented as a policy tool, as a way to organize thinking on the analysis and understanding of how innovation can be nurtured and how socio-economic change can be accelerated (Hall *et al.*, 2004).

The innovation system concept is derived from direct observation of countries and sectors with strong records of innovation. The concept has been used predominantly to explain the patterns of past economic performance in developed countries and has received far less attention as an operational tool. It has been applied to agriculture in developing countries only recently, but it offers opportunities for understanding how a country's agricultural sector can make better use of new knowledge and for designing alternative interventions that go beyond research system investment. This study does not challenge the importance of investing in science and technology capacity which is well recognized in innovation systems theory, rather it focuses on the additional insights and types of interventions that can be derived from an innovation systems perspective and that can influence the generation and use of Science and Technology for economic development.

Innovation system framework focuses innovation (rather than research) as its organizing principle. The term innovation is used in its broader sense of activities or processes associated with the generation, production, distribution and use of new technological and institutional, organizational and managerial knowledge. Innovation systems conceptual framework has been used for analysis. This framework draws theoretically from institutional economics and uses empirical evidence from the changes in a particular innovation. This will give a better understanding of opportunities for policy interventions to strengthen innovation system functioning in developing countries.

3. Methodology

The study started with basic desk research on exploring various agricultural innovations and two agricultural innovation systems; ***Organic Agriculture Innovation System and Hybrid Seeds Innovation System*** were selected for analysis. The two sectors had all the criteria's that could capture elements of the dynamic agricultural context in the country (IBRD, 2006). These two sectors are among the fast growing and niche sectors. They also represent traditional sectors being transformed by growth of activities further up the

food chain in agro-industrial transformation, for their employment potential specifically for its relevance to rural employment on one hand and role in exports for its integration to global market. Literature available for both the sectors were explored mainly through various reports, books research papers and interviews with the key informants/sector specialists in the country. Literature on agricultural innovation has largely ignored the role of PAs For example, Clarke *et al.*, 2003 (that do consider the response of The Horticultural Society of India (a PA), which ideally ought to have addressed the concerns of tomato growers in the hills) in the Raina, 2004 paper, the case of enabling cheap affordable micro-irrigation and pomegranate cultivation in the arid lands of Sholapur (Maharashtra State in India) describes the relationships between the different actors farmers, retailers and manufacturers do not mentions PAs as one of the actors in water, while there are plenty of them especially in groundwater. Besides an innovation system diagnosis of the case of Vanilla production in Kerala (India) (Sulaiman, IBRD, 2006), that explores the scope of actors, their activities and the roles finds no evidence of the PA in the spice or tea industry which actually has played a role in bringing scientists and traders to address some of the crucial market failures and crop quality/production concerns. Unless there is explicit acknowledgement of the ways in which scientists organize themselves in society –and address particular crop/ market issues, there is limited scope to explore how science can respond better to social concerns.

The review of the innovations being explored is based on the published and grey material derived through interviews and contacts with key informants or sector specialists engaged with OA and HS innovation system in the country. Domain map for both sectors was prepared through sectors mapping to locate various actors and organizations in the two innovations systems, to explore their roles their skills and competencies, extent of linkages between actors and organizations, nature of these linkages (Hall, *et al.*, 2006). PAs are present in both the sectors.

The domain maps for the two innovation systems were prepared by:

- Identifying range of actors present, an inventory of innovation actors, role of different actors.
- Actors in the domain have been broadly classified into: *The research domain, enterprise domain, demand domain and the intermediate domain*
- Domain map reflects the range of innovation actors, extent of relationships existing among the actors, relationship dynamics—nature and dynamics of relationship between the entire and location of PAs on this map
- PAs then acted as reference point and were located as important actors in this domain map and nature of linkages, interaction and learnings in the sectors were actually explored in detail by exploring four innovation system features of these PAs along with other actors and organizations in their respective innovation systems.

Exploratory Survey:

Interviews with the key informants or sector specialists were open ended with no strict format as they were aimed to get an understanding on the various key actors or organizations present in the respective innovation system. This involved interviewing the key persons/office bearers of the PA using a template with a list of questions. A flexible

template, and not really a structured questionnaire were used for interviewing where you can ask different questions depending on the organization or individuals. *Survey began by identifying PAs in the research domain relevant to the innovation systems selected for this study. These were R&D based PAs and absence of PAs playing any roles the innovation systems was soon realized. This made imperative to select PAs, which were located outside the R&D system and were playing important role in the innovation system. This led to exploration on the role of PAs outside the formal R&D that enabled innovation.* Most of these PAs were located in the enterprise domain and served as the starting point, while their linkages or interactions with other sectors and organizations helped in diagnostic assessment of identifying their role in the innovation system. PAs related to OA were, All India Organic and biodynamic farming Association (AIOBFA) in Indore, Association for Promotion of Organic Farming (APOF), Organic Agriculture Society for Integrated services (OASIS). While PAs related to Hybrid seeds were Seed Association of India(SAI), Association of Seed Industry (ASI) and Indian Seed Industry Association (ISIA) and All India Crop Biotechnology Association (AICBA formed in 2003). All these PAs are located outside the research system, although origin of most of them could be traced back to individual efforts once they get out of the research system. PAs located close to the research system in the respective innovations systems (OASIS and HSIS) like Indian Society for Soil Sciences (ISSS), Indian Society for Seed Technology (ISST) and Indian Society for Plant Breeding and Genetics(ISPBG) were also explored for their roles.

Nature of questionnaire template

A non-structured template questionnaire to capture innovation system features /processes was designed to guide the interview research and explore the selected PAs and other linked actors/organizations to explore their roles in the respective agricultural innovation systems (Seen Annexure for list of questions). The list of questions tried to know the kind of role they play in their innovation system, how they pay that role, the nature of their interactions with other actors, their structure, about office bearers background, their networks and expertise, why they got established and where they have reached and how do they see themselves evolving overtime etc. (*Annexure I*).

Comparative analysis

Although to begin with it was not intended to be a comparative analysis but during the course of the study it was found useful and thus was attempted. Comparison was done by comparing the presence and nature of four innovation system features of the PAs present in the two innovation systems.

Innovation system diagnosis and assessment

Information collected using this template was used to explore the presence or absence of four innovation system features among these PAs. These four essential innovations system features have been derived from the innovation systems framework- the analytical framework that has been used for this study (IBRD, 2006). This diagnosis helped in identifying the gaps in their roles and where interventions could improve the capacity for innovation of these PAs.

4. Organic Agriculture Innovation System and its innovation potentials

Organic Agriculture Innovation system (OAIS) refers to the interlinked and learning network of organizations and individuals together with institutions and policies that affect their innovative behavior. Organic Agriculture (OA) movement over the globe is entirely market driven and in response to concerns of health and quality consciousness arising from widely perceived adverse effects of chemicals which have come to be increasingly used in conventional agriculture. OA is not a production driven as most of the agricultural innovations are rather then it is market driven and the production of organic products, its trade and consumption environment is increasingly dynamic and evolving in unpredictable ways. The knowledge, information, and technology are increasingly generated, diffused and applied through private sector with India representing range of geographical area is seen with lot of scope for exports. OA means the use of chemically produced fertilizers and of pesticides against weeds, insects, fungi and bacteria is strictly controlled. It is often termed knowledge –based rather than input –based agriculture as in conventional agriculture. It requires appropriate field management practices to be developed and improvised depending on the particular case and nature of locally available material (Das, 2007). To be able to sell “organic” do not mean simply that it was grown without chemical fertilizers, but one need to have the entire production certified by an independent body. Going organic means moving along certain guidelines to ensure fair practices in international trade of organic food, the Codex Alimentarius commission, a joint body of FAO/WHO framed certain guidelines for the production, processing, labeling and marketing of organically produced foods (FAO, 1999)ⁱ. OA has its roots in the variously named ecofarming, biological farming, biodynamic, regenerative agriculture, nature farming and permaculture movements, which have developed, in different countries (Crucifix, 1998). In India also it gets various names like, traditional agriculture, sustainable agriculture, *Jaivik Krishi* etc. There are different opinions on nomenclature with lot of debate on what could be classified as OA or not (Palaniappan, 2004). Without going into definitions and objectives of OA, this study explores OA by identifying various actors (organizations/institutions) that are associated with OA in India through the role played by the PAs, as one of the actors, their relationship with other actors to produce new knowledge /process in the broader OAIS. OA has been explored as an innovation, which has worked in a very different way with different sources of knowledge, different institutions and learning processes. Role of PAs has been explored as innovation system actors for their engagement with the key professional and social issues that confront OAIS.

4.1. Organic agriculture in India: actors and institutions

Organic agriculture (OA) stands apart from of developments in the mainstream AIS in India. This distinctiveness comes from initial efforts by the farming communities and agri-enterprises and only later being carried forward by other stakeholders along with the Central and several government organizations/ departments. OA as an agricultural growth strategy in India has two dimensions one is its growth as important export sector and other is its potential of growing as important livelihood option for small and marginal farmers who look for a low input based ecologically sustainable farming especially in rainfed areas. The later one has found more favor for its objectives to increase soil fertility, productivity and sustained production with reduced external inputs to make farming profitable and for alleviation of rural poverty (Veeresh, 2005, 2006). With emphasis and inclusion of OA as a major component, Ministry of Commerce created organizations and institutions to address first dimension, second dimension is mainly addressed by bringing in central support through various schemes funding schemes that supported small /marginal farmers and rural entrepreneurship. Efforts have also been made to bring synergies between the two ministries by participating and representing

Figure 1: Organic Agriculture Innovation System: a domain map

Defining context –History

Traditionally organic agriculture-in the 1950s 1960s-indiscriminate pesticides use, chemical farming hazards-safety concerns 1970s-demand for ecofriendly agriculture international standards laid for OF-with certification bodies across the world 1972-1990s 2000-increased global market demand-Government, Donors, state sponsored initiatives

Enterprise Domain

Farmers/farmer groups/organizations Pvt. Companies organic input producer, organic products producers Processors, consumer organizations

Cooperatives, Inspection and certifying agencies under NPOF by APEDA

*Projects
Transport assistance
Professional associations (informal)*

Institutional/policy Domain

2000-landmark year—Planning commission, Govt.of India OF – major thrust in 10th five year plan/N_E /rainfed regions National Agricultural Policy (2000), MOA, State policiesin many states Recommended promotion of traditional knowledge/scientific upgradation of OF 2001-National Programme for Organic Production (NPOP), GOI, MOC Laying down standards for accreditation Central Govt. Institutions, State Govt. Institutions, commodity boards Trade regulations

Research Domain

R&D Still seen as traditional agricultural practice ICAR-central govt. institutions little effort/new scientific knowledge in the interrelated disciplines SAU', NRM division PD-cropping systems research, developing POPs for of Research stations& universities, Professional associations (formal R&D based)

Intermediate Domain

APEDA, Min of Commerce as implementation agency of OF stds. Central sector scheme-National Project on organic farming(NPOF MOA, GOI production promotion and market development of OA in India, For implementing NPOF, National Bio fertilizers Development Centre estbsd in 1984-85, ,converted to National Centre of Organic farming since 2004, with head quarters at Gaziabad- 6 regional sponsored centers, Commodity boards, Quality analysis laboratories Indian/international. NGOs, processors

Demand Domain

Global Markets for organic produce Domestic market demand, Food export industry organic Corporates, consumer organisations / private industry Traders and exporters (profit organizations) Importers

each other activities³. However, it has been well recognized that to ensure that OA is the answer to the sustainability problem, it has to be adopted to the local farming, social, geographical and climatic factors. The interest related to OA in India is growing for its smaller requirements for financial inputs and its more reliance on the natural and human resources available. This emphasis on use of local resources and self-reliance, conversion to OA is seen as a way to the empowerment of farmers and local communities (Ramesh, *et al.*, 2005). India's approach initially has been mostly farmer oriented, however recently market oriented approaches have emerged in the form of public marketing supports like, retail outlets, certification agencies, commodity boards promotion etc. The European structure of OA specially its current market driven style is not necessarily the most appropriate system suiting Indian conditions. (Pratap, 2006).

The next sections explore evolution of the OAIS, various actors, their roles and institutions, their linkages or relationships among each other using innovation systems perspective linking to the next section that will specifically explore PAs their roles, relationships with the above actors and institutions and innovation system features they possess.

4.1.1. Evolution of Organic agriculture in India

OA was largely initiated through India's civil society/private organizations, and assessed its many competitive advantages in certain crops for export, only later did the potential benefits of OA for small farmers became widely appreciated and government started participating more actively. These efforts were initiated by local NGOs or the private organizations, which could be traced back to their links with the international organic movements mainly, International Federation of Organic Agriculture Movements (IFOAM)ⁱⁱ, Germany mainly through its members and associates discussed in the next section. The IFAOM has over 600 organizational members from 120 countries and India is one of them. So the initial efforts in establishing OA in the country was mainly initiated and motivated by external (European) influence and foreign projects which were later maintained by local NGO's with ongoing support from their foreign partners. Most of the OA efforts in India initiated before the Government had a policy in place for OA (Table1).

OA started getting attention first at the state level, with a number of States that have taken initiative for example, governments of mountainous States of Uttaranchal, Mizoram and Sikkim have taken the initiatives to turn and declare their states fully organic. This has been followed up by initiatives in other States like, Karnataka, Madhya Pradesh, Arunachal Pradesh, Meghalaya, Maharashtra, etc., (Figure 1, see Institutional Domain) Initiatives from central government also followed and they aligned well with the increasing international trade that demand recognizable safety standard. The uniqueness of OA in India comes from the real initiatives starting from the State (Uttaranchal)ⁱⁱⁱ and its great strength was personal motivation of some individuals and expertise of key

³ Communication with Dr. Dave, Director, APEDA

individuals^{iv}. All these efforts have mostly been international market driven. There are active linkages between the Indian and global players – the interaction being much more intense than the interaction with the local government which respond later to all these efforts. There were on-going projects of organic cotton cultivation run by Maikaal BioRe⁴ India, ICCOA partnering with FiBL (Research institute for Organic Agriculture) Switzerland to execute Indian Organic Market Development Project (IOMDP) funded by Secretariat of the Economic Affairs (SECO), Switzerland etc.

Table 1. Evolution of Organic Agriculture in India: actors and institutions

Sl.No And year	Event/ Intervention	Actors involved	International/ Domestic drivers
1. Early 1990s	Albert Howard's also called as father of modern OA, developed composting processes (Mycorrhizal fungi) at Pusa, Samastipur, India and published document----an Agricultural Testament.... Development of Indore method of aerobic compost (1929) Bangalore method of Anaerobic Compost NADEP Compost Pusa Permanent Manurial Experiments in 1930s and terminated in 1969 replaced by All India Co-ordinated Research Project on Long Term Fertilizer Experiments	Sir Albert Howard, a British agronomist in North India. Acharya, 1934 ICAR	Inspired by Rothamsted Classical experiments
2. Late 1990s	Various scattered interventions in the form of model farms demonstrating organic farming and biodynamic practices through group of farmers, with crops specific to agro-ecological zones, various states, post harvest operations.	Private efforts mostly through their association/membership with the efforts on OA and biodynamic agriculture The Eco-Agri Research Foundation (1994) (registered trust NGO (Karnataka) "Shiwalik Hills " Integrated Watershed Development Program (Punjab, Haryana, H.P., J&K, Uttaranchal).. Institute for integrated Rural Development(IIRD) (Maharashtra) Maikal Cotton Research Project—private company I behalf of yarn trader Remei	Rudolph Steiner (1922) philosophy on biodynamic farming, IFOAM, establishment in 1972, One straw revolution- book released by Masanobu Fukoka (1975) an eminent microbiologist in Japan Market orientation, inspired by members and Associates of IFOAM Both Export USA, Europe, Domestic through traders Government managed &WB financed, regional market orientation + exports through agents in Delhi and Bombay. Mostly domestic local promoting organic bazaars in urban areas Initiated in 1993 by a major Swiss yarn trading company, together with Maikaal Fibers Ltd. An Indian Spinning mill.

⁴ In a 3-years research project, FiBL has analyzed the impact of organic cotton farming on farms of the Maikaal bioRe project in India. The results show that conversion to organic cotton farming can significantly contribute to improving the livelihoods of smallholders as it generates higher incomes and involves less risk. At the same time, it allows a more sustainable management of natural resources. Funded by Swiss Agency for Development and Cooperation (SDC) and World Wide Fund for Nature (WWF), Switzerland.

		Peermade Development Society Experts (Kerala) training and marketing for marginal and tribal farmers	Religious organization (Christian diocese. social service) in response to agrochemical contamination in the region.
Year 2000 and later	<p>Four major happenings:</p> <ul style="list-style-type: none"> - National Steering group that identified OA as a national challenge (2000) -National Agricultural policy recommending OA (2000) - Task Force on OA recommending OA promotion (2000) -National Organic Programme launched in April 2000 with APEDA as implementing agency of National Programme for Organic Production (NPOP) -National Steering Committee (NSC) for monitoring overall organic activities under NPOP -Accredited Certifying and Inspection agencies approved by APEDA (2001) Accredited some of the earlier existing certifying agencies for certification -Efforts to accredited domestic certification agencies also -Symposium on Organic farming (2002) -State of Uttaranchal declared as “Organic State” (2002) -Annual exhibition of organic agricultural produce and products through Organic fair in Coimbatore (2003) - The First National Seminar on Organic Farming for mountain States was held in Dehradun in Nov’ 2003* - Karnataka declared its Organic policy; Mizoram and Sikkim joined in the league early 2004. The Maharashtra government declared its most progressive regions are organic priority regions. Facilitated the Maharashtra Organic Farmers Association (MOFA) in April’ 2004. International Center for competence on Organic agriculture (ICCOA) set up in Bangalore by FiBL, Switzerland. (2004). 	<p>Planning commission</p> <p>Department of Agriculture and Cooperation, Ministry of Agriculture Ministry of Commerce</p> <p>Comprise of Ministry of Commerce, Ministry of Agriculture, APEDA, Spice Board, Coffee Board + various other public and private organizations related to OA.</p> <p>Three private certification agencies for the certification of organic products ... Institute of Market logy, Bangalore; SKAL India, Bangalore and ECOCERT, International Germany.</p> <p>Some of them like Uttranchal State Certification agency (USCOCA), Natural Organic Certification Agency (NOCA), APOF Certification agency (AOCA)</p> <p>Domestic efforts Indian Society of Soil Science, involved scientists, regulatory mechanisms evolved by APEDA, private entrepreneurs experiences, farmers perceptions UCOB, State Departments of Agriculture OASIS, university of Agricultural sciences Bangalore</p> <p>UCOB, State Department of Agriculture, other stakeholders in OA Govt. of respective states UCOB, DAC, Ministry of Agriculture, Govt. of India</p>	<p>EU regulation on Organic food, 1991 Codex guidelines on organic standard, 1999</p> <p>Domestic needs raised through various forums, like seminars/workshops organized by diverse organizations like, NGO’s, private organizations, trusts, professional /farmers associations (APOF, OFAI, AIOBFA, OASIS), national agricultural academy of sciences + other agencies involved in domestic marketing of organic produce in India like, NAVDANYA, FAB India Overseass pvt., Ltd. Devbhoomi etc.</p> <p>They build on these certification agencies earlier approved by European Union and their certification accepted by importing countries.</p> <p>Certification by internationally approved agencies very rigorous and costly. Internal Control System approved by IFOAM and Codex for small farmers for adopting organic standards at minimal cost and hassle.</p> <p>IFAOM in collaboration with Indian partners</p> <p>Organizations like, UCOB, MOFF, ICCOA, OASIS, INORA, OFAI along with several other stakeholders like farmers organizations, exporters, certification bodies, APEDA, several individuals were part of these efforts</p>

<p>-Central Scheme on National Project on Organic Farming with outlay of 57.05 crore on pilot basis for 10th 5 year plan (2004) (late by two and a half years) officially recognizing the Organic Movement in the country.</p> <p>-OA also promoted through projects like Technology Mission on Horticulture, Cotton etc at the Centre/State level, Task force on balance use of fertilizers---suggest mechanisms for encouraging use of organic manures and biofertilizers</p> <p>-Technical Cooperation Programme (TCP) of FAO Development of technical capacity base for promotion of OA in India ... to overcome knowledge gaps, ecological zones based organic crop production of packages etc.</p> <p>-Policy paper on Organic farming (2005)</p>	<p>National Centre for Organic Farming (NCOF), with Head quarters Ghaziabad, and 6 regional centers at Bangalore, Bhubaneswar, Hissar, Jabalpur, Imphal and Nagpur</p> <p>OA integrated with other State level schemes /projects/missions</p> <p>Ministry of Agriculture, in cooperation with diverse organizations (like, MOFF, INHERE)/individual consultants</p> <p>DAC National Academy of Agriculture Sciences</p>	<p>Conversion of erstwhile National Project on Development & Use of Biofertilizers (Ministry of Agriculture) that was initiated in during 1983 into NCOF along with its six regional centers for Organic farming in 2004. This gave more relevance to the earlier programme.</p>
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Source: GOI, 2001, Gouri (2004), Bhattacharya & Chakraborty (2005).

*Shri Som Pal, Chairman National Commission for Farmers Stressed on Organic Farming for Mountain States.

OA in India thus has been operational under varied institutional arrangements. Civil Society (NGO's, farmers groups) plays the primary role in Indian organic sector, seeing the benefits and business opportunities now private companies have now increasingly taken a role in organic development. Farmers are the major actors in the OA and have been supported/organized through various organizational structures ranging from, private companies, operating under NGO's initiatives/societies, organized and facilitated by government or forming their own organizations (corporations, associations, self-help groups etc.). These diverse organizations were actors that led to the streamlining of the procedures and rules and policies from the Government where the private organizations were either Indian or foreign supported in the form of Trusts/NGO', Associations of farmers/professionals, societies, agri-business corporations, State Board etc. These organizations provide a complete range of organic services including training, projects set up, marketing links, certification of organic farms/organic inputs/organic produce etc. some of the well-known organizations like, International Competence Center for Organic Agriculture (ICCOA) formed in response to the need felt ⁵ of an interface organization to understand the happenings in the organic movement and promote and facilitate OA among the farmers in India (*Annexure II*). They have been successful in organizing two successful trade fairs and were successful in bring various stakeholders together through this platform and also were able to raise business through it. Organic Farming Association of India (OFAI) which works through various member farmers' organizations in various states, like Maharashtra Organic Farming Federation (MOFF) in Maharashtra and Tamil Nadu Organic Farmers Technology Association, in Tamil Nadu. Both also serve as technical resource center in Tamil Nadu for OFAI. Individuals committed to OA lead most of these farmers associations⁶. Institute of

⁵ Workshop was organized in NAAS complex in which various stakeholders related to OA with participation of private organizations, NGOs, Scientists etc.... that recommended the need for an organization and ICCOA was formed.

⁶ Claude Alvares, an environmental activist is the main person behind OFAI institutionalized through grassroots organic farmers associations which also serve as State secretariats in the country.

Natural Organic Agriculture (INORA), which is a think tank of scientist, social scientists, economists and industrialists with a main objective of research, development and promotion of organic farming techniques and production of organic farming system inputs (Annexure I). Besides there are also private companies like, Kumar Krishi Mitra Bioproducts (1) Pvt. Limited^v a private company and have been into the production of microbes over 3 decades, with more than 5000 microbial isolates from varied agro-climatic zones in India, however most of the production is for export, so they are into profit making with these products. The company has many patents, and awards to its name with largest exporters of microbial products to over 10 developed and developing countries. They have strong linkages and updated with ongoing/latest research with organizations like, ICRISAT, but very little associations with Indian research and development system or the public sector organizations as such. There are some individuals who have taken up initiatives for retail outlets and are also into production and marketing of organic produces in the domestic market. They facilitate to bring together farmers together and also provide them retail outlet and demand based production. Some dedicated individuals⁷ having local retail outlet are also important actors into production and marketing of organic produce in the domestic market (Coimbatore). This helped retail to link up with farmers for need based products and also providing a common platform for interactions among stakeholders. Interactions involve listening to farmers' problems from all part of Tamil Nadu (retail initiative by a few women makes the men of other professional organizations involved in the sector little envious).

All these diverse organizations are mostly located in the enterprise domain and are often linked to the actors in the demand domains of the OAIS and are often closely linked to each other based on the need (Figure 1). These domains are independently linked to the intermediate domain that is basically a facilitator of OA through projects funding and procedures laid down for organic production. Now with support coming from the Government most of these organizations are trying to link to the government funding as well as networking with other similar organizations in the OA. They often exchange their experts for imparting trainings etc. in various processes associated with organic farming. These NGO's in their own ways are trying to provide scientific/technical inputs that otherwise research organizations are not providing in their own ways by advocating crop-based packages of practices for local situations. Some of them are even trying to refute popular view of scientific establishments viewing OA as unscientific and unproven, by providing supportive data for it. And offer OA as solution for indebted farmers in the suicide prone areas⁸.

4.1.2. Government role and policies

In India there are signs of shift towards organic over the past few years. Overview of organic production and trade estimated that about 228 million US\$ was the value of export in 2005-2006 and is expected to increase in the future (Table 2)(Dr. Dave,

⁷ Mrs. Shantaramaswamy, owner of Shreevatsa organic farm products (personnel communication).

⁸ <http://www.indiatogether.org/2006/aug/agr-orgsci.htm>

APEDA). Governments initiatives to promote OA in India began in 2000, although it was being already practiced by farmers through some export oriented private companies or as an sustainable agriculture approach by NGOs (Figure 1)...see institutional/policy domain). Initiatives first started through the planning commission, which constituted a steering group on agriculture that identified OA as National Challenge and suggested it should be taken in the form of a project as major thrust area for 10th –five-year plan. The group recommended OA for Northeast region, rainfed areas and in the areas where the consumption of agrochemicals is already low or negligible. Other initiatives tried to bring synergies among the various government departments. National Agricultural Policy (2000) recommended promotion of traditional knowledge of agriculture relating to OA and its scientific upgradation. Policies were delineated for placing down the National organic standards comparable to international standards is already in place (Table 1). The central government initiated its allocation of funds with the tenth five- year plan. Hill States like Uttaranchal look a lead with other small states following and Mizorum have declared themselves as organic States. Similarly other States like Karnataka, Maharashtra, Tamil Nadu, Kerala, etc have also come or are in the process of delineating policies in favour of organic agriculture.

Table 2: Organic production and trade in India (2005-06)*.

Area under certification	2.50 million Ha.
Area under cultivation (7.2%)	0.18 million Ha.
Total certified production	378244 MT
Projects certified	332
Accredited certification bodies	11
Number of products exported	35
Total quantity exported	15, 137 MT
Total value of exports	US \$ 228 million

Source: Dr. Dave Director (APEDA)

**These figures are based on the data received from certifying agencies.*

The Indian Government recognizing the export potential of OA has set up a regulatory framework (standards, accreditation regulations) for the development of OA at national and international level. This included creating organic standards and the possibility of accrediting in-country inspection and certification bodies. Agricultural and Processed Food Export Development Authority (APEDA) under the Ministry of Commerce is the coordinating agency for organic food production and export under the brand name “India Organic”. Launching National Organic Programme complemented this process and APEDA was given the responsibility of implementing the National Programme for Organic production (NPOP) (Gauri, 2004). Under NPOP, documents like National Standards for accreditation, inspection and certification agencies. Accreditation procedures have been prepared and approved. These National Standards for Organic export. By NPOP have been accepted by Ministry of Agriculture for Domestic purpose also. These standards lay down policies for development and certification of organic products, facilitation of certification of organic products, institute a logo “India Organic” and prescribe its award by accrediting bodies. A national Steering committee (NSC) comprising Ministry of Commerce, Ministry of agriculture, APEDA, Spice Board, Coffee board, Tea Board and various other government and private organizations associated with

organic movement monitors the overall organic activities under NPOP. NPOP has also got equivalency with EU standards and NOP standards of USA. Along with the standards, implementation of these standards is done through certification programmes^{vi}, which is among the most important parts of OA, specifically concerned with the export of organic products. Certification is done through accredited certifying and inspection agencies, which are now 12 in numbers and are accredited and evaluated regularly by APEDA⁹. Tariff structure of these bodies vary a lot with Indian agencies coming up with lower tariff rates compared to certification bodies. Local certification is an important step, but few of the national certifiers have sought international (IFAOM) accreditation, for local certifiers; there are emerging domestic certifiers^{vii}. There is a credibility issue, with the important organic producers (such as Navdanya) seeking international certification and even being somewhat derisive about the local certification agencies (how local certification work is an outcome of the PA and their links will be discussed later) (Annexure 2).

Task force constituted by the Department of Agriculture and Cooperation, Ministry of Agriculture also recommended promotion of OA. The Department of Agriculture and Cooperation and Ministry of agriculture institutionalized its efforts for Organic farming by launching a Central Sector scheme “National Project on Organic farming in 10th five year plan for the production, promotion and market development of organic farming in the country on the pilot basis (Table 1). There was conversion of erstwhile National Project on Development & Use of Biofertilizers (1983) into National Centre of Organic Farming along with its six regional centers in 2004. This led to the dovetailing of activities related to OA to its earlier objectives of promoting sustainable, cost effective microbial inoculants as biofertilizers. Additional objectives also include capacity building through service providers, financial support to different kind of production units of biofertilizers compost, vermin compost, Human resource development through training on certification and inspection, production technology, field demonstration on OA, model organic farm, domestic, support to new technology initiatives etc. (NCOF, Annual Report, 2005-06). Besides Ministry of Agriculture also supports OA through projects like, Technology Mission on Horticulture, cotton Scheme, promotion of vermin compost, development of biovillages^{viii}, Macro management programs in various states, and some of the programmes with external agencies like FAO^{ix}. NCOF has come as a facilitator for promoting OA by providing assistance to organic entrepreneurs and farmers with a major task of making available the organic inputs and low cost certification processes. NCOF also plays the role of monitoring and testing inputs used in OA^x. As some experts view the inadequate availability of biofertilizers and bio-pesticides as a limiting factor in the growth of OA this particular sector is getting lot of encouragement from the Government from the NCOF, for organic to take off. Others view this as a corporate lobby at work and an effort to create a new breed of industrial units churning out so-called bio-fertilizers for the organic farming community. The view that OA as a holistic approach that makes the farmers self reliant, and not dependent on kind of external inputs that are beyond his farm production, looks OA as a move towards crop rotation, manuring, mulching and a host of other homegrown methods for enhancing soil fertility and yields

⁹ <http://www.apeda.com>

especially in the context of its scope for small /marginal farmers /against the interest of small and marginal farmers (Mahale, 2002)¹⁰. OA has predominantly been viewed by the government as a means for earning export revenues rather than an alternative model of agricultural development. This is evident from its being a major subject under the purview of Ministry of Commerce rather than the Ministry of Agriculture. Ministry of agriculture also emphasizes more on the training /capacity building initiatives for the inputs needed for organic production, which is not in favor of the very spirit of OA according to the local OA associations which emphasize on production of inputs either from within the farm or from locally available resources without relying on outside inputs¹¹. This philosophy of external input based agriculture has percolated from the research system, which otherwise has largely remained isolated from the debates and questions related to OA. This sees OA similar to the chemical based agriculture in its approach to knowledge generation and utilization – which is linear and sees farmers are ultimate beneficiaries or adopters of ‘technologies’ handed down by the Ministry or its training programmes. Whether it is organic or chemical based agriculture, the Ministry then ends up promoting the ‘input intensive mode of agriculture.’ And does not enable innovation capacity within the group of OA actors.

4.1.3. Response of the Research system

OA in India is mainly thought of as closely aligned with traditional forms of Indian agriculture. Initiatives taken up by the research system were largely in response to the earlier emphasis by the central government given to OA. Responding to the central governments initiatives twelve of ICAR institutes have been given a mandate to move into organic production as a main or sideline to their mainstream research to overcome knowledge gaps –providing basic information specific to various soil and ecological zones, developing integrated Packages of Practices (POPs) for organic crop production practices, improved input production utilization and certification issues. Research system, scientific bodies have not responded like, developing context specific germplasm resistant to viruses, or developed methods to biologically control local insects. This has not been looked in the light of new scientific knowledge in all interrelated disciplines like, soil sciences, microbiology, plant breeding, social sciences, etc.

Clearly there is a need to evolve scientific understanding for this emerging farming strategy. It is apparent that the way to define questions and to look for answer would require a departure from the way scientific community has approached the problem only through a disciplinary way. While efforts thus far have been limited this is an area that will certainly require greater scientific efforts. Most of the efforts are outside the domain of research system (ICAR labs, SAUs) despite many efforts from other actors above for example, MOFF. These have been mostly supported by organizations like, IFAD and Government of India. Despite the efforts of international agricultural system (ICRISAT), the Indian research system has not learned any lessons from it. ICRISAT has studies/linkages with the actors like, private sectors producing biofertilizers etc, NGOs

¹⁰ Prabha Mahale, exerts from interview with Naren Karunakaran.

¹¹ Dr. Veeresh, Director APOF, interview

and other actors of this innovation system. Efforts have been made to learn from the practitioners of OA and examine how and where can scientists contribute. As microbiologists they have even worked to know the formulations/protocols used in OA to know how and why they work (Rupela, 2006)¹². This work has been published also. Indian research system has different crop based organizations coming out with various packages of practices only, ICAR has not even build on its findings from its own long term manurial trials (Jackson, 1999). OA is thought of as a good option for the Dry land farming and farming in the tribal and Hill states, as transition would be easy little research efforts are visible from the traditional research system, which still prefers to work in isolation.

Studies on Organic farming

Evaluation/impact studies on OA have been done mostly by external funded organizations, and that too to explore market opportunities and challenges for Indian organic products (Garbay & Katke, 2003). They have mostly explored in order to see and support Indian NGOs to set up internationally recognized organic certification program with an aim to improve livelihood of small farmers by improving market access both domestic and international. Agricultural education in organic or sustainable agriculture is rarely available at the university level, and is still focused on green revolution models of farming (Das, 2007). Although ICAR has been part of the meetings /workshops organized by other actors they see mostly themselves as experts and do not attend these meeting to integrate the concerns raised into their research agendas or education like ISSS organizing a symposium on OA and coming out with a set of recommendations (ISSS, 2004).

In India, while there are claims that area under OA is increasing rapidly but reliable statistics are not readily available, and whatever statistics are available, they are based on the data generated by the certification bodies, basically a sum total of areas certified as organic by these certification agencies (Table 2). There has been practically no effort by public R & D organizations to collect data on various aspects of OA or identify researchable issues and ways to address the problems. Still OA is criticized for its ability to produce less compared to the conventional agriculture and its inability to meet the food production targets for the growing population and not beyond production for its other environmental and social benefits. Although National Projects on organic farming launched in 2004 along with national agricultural policy has given priority to the dry lands, which lack local food security and employment, little has been achieved so far that could integrate well and use OA as one of the strategies to improve the potential of these areas (Sharma, 2005).

Major Issues associated with OA

- *Two main typologies of OA innovation*

Although varied institutional arrangements were responsible for taking ahead the movement of OA in India, their interest vary sometimes and they get carried away by the profit motives and small and marginal farmers are not actually getting help.

¹² Views of OP Rupela on Organic Farming, Draft outline of a paper

Sometimes small and marginal farming community being marginalized with lopsided emphasis on exports much to the detriment of domestic markets. OA in India is still considered as small-scale endeavor. The export market for organic products is in practice really for the big private investors who can invest in the certification process that will allow them to sell well. Such procedures are almost always carried out by organizations that are very costly.

- *Economic benefits vs. capacities to learn and master the markets, certification processes, soil and water quality, etc.*

While some of the private organizations concentrate on potentials for the economic benefits, NGO's, and other grass root organizations concentrate on supporting the farmers through trainings and capacity building programs which they do mainly by playing the role of field service providers employed under the Internal Control System (ICS) that provide a vital link between the growers and certifying agencies. They help growers in adoption of right practices and inputs, maintenance of proper documents on a regular basis, liaison with certification agencies and all other related jobs like packaging, labeling and marketing etc. A service provider may serve 1000-1500 farmers in cluster of villages. These service providers could be State Government/ICAR/SAUs/KVKs/NGO's etc (Sharma & Singh, 2004).

- *Certification costs – knowledge and criteria owned by actors external to the system*

Certification and related cost appear to have become a major impediment for OA many producers and activists are actively exploring alternative ways of certification like, group certification through an evaluation of ICS, participatory guarantee system (PGS). The government has also approved these alternatives as well^{xi}. As more and more producers are engaged in contract farming with corporates and exporters the certification is often issues in the name of the company or the exporter, and not the farmers leading do their exploitation. This situation has emerged because producers are reluctant to bear inspection/certification costs and have signed away their freedom to the exporters who bear the expenses involved in certifying and getting the produce to the foreign market. Besides the problem of the costs of certification, lack of information by the farmers is another obstacle to adoption of organic production.

- *Different typologies – different leadership and membership, and different governance mechanisms*

Integration or inclusion of marginal and small producers in the organic supply or value chains or production networks of the lead firms could be done by understanding how these chains are organized, controlled and governed and gains are shared across the participants (Singh Sukhpal, 2006). NGO's led organizations are more common in India, they excel in issues of farmers equity and resources management, but do they have sufficient business skills to succeed at marketing or needs related to post harvest, processing and marketing need for the farmers. Sources for organic planting materials, fertilizers, and bio-pesticides necessary for organic adoption, investment in certification and secure (non-contaminated) storage, processing and transport are necessary for OA.

In India, initiatives have begun that look at OA innovation as an alternative to small producers for domestic purposes, for decreasing dependence on the external inputs, environmentally safe mode of agricultural production. This has led to proliferation of a network of organizations of various nature like, NGO's, producer organizations, private companies, consultants, private trusts and PAs responsible for working and looking at OA as a potential strategy to bring self reliance, less dependence of external input to decrease the burden of the farmer and cater to domestic needs. PAs among them have been identified as one of the innovation system actors and explored to understand their capacities in the India OAS. PAs are special because they are group of professionals who have taken up OA to play a dual role for furthering the interests of the profession and its social relevance. OAS has been explored through the role of PAs and its linkages with other actors.

4.2. Professional Associations as Innovation System Actors in OAS

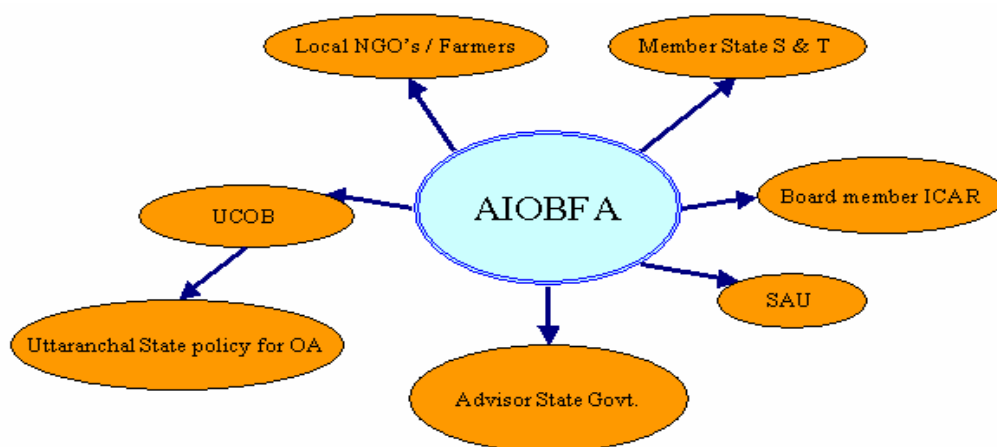
Innovation systems framework has been used to explore the presence and the role of these actors who have not been much mentioned in the literature^{xii}. Although these PAs have been complementing the role being played by other actors in the innovation system, they are rarely mentioned as important players /actors in the OA innovation system. This study explores their role by locating PAs as “innovation system actors” in the OAS. It uses the four features of innovation systems as the main analytical categories to understand the presence, interactions and roles of PAs in enabling OA innovation. The four features of an ideal innovation system are:

- *Presence and interaction of several organizations/actors with bringing of different sources of knowledge*
- *Focus is on both technological as well as institutional change/innovations*
- *Evidence of learning and behavioural changes*
- *Creating or enabling policy and institutional environment*

PAs in the OA innovation systems are all initiated by professionals – either an individual scientist committed to OA or a group of like-minded scientists committed to OA. Origin of PAs emphasizing OA in India can be traced back to 1995 when All India Organic and biodynamic farming Association (AIOBFA) was formed in Indore mainly comprising of retired scientists and activists. This association actually formed a basis for a major organic movement in Uttaranchal, that led to the formation of a dedicated State supported organization called Uttaranchal Organic Commodity board (UCOB). UCOB anchored a Centre of organic farming which was mainly supported by Sir Ratan Tata Trust was responsible for the widespread organic farming movement in the State (Annexure I). AIOBFA, is one of the initial organization that set off with a social cause to serve the farmers and promote alternate ways of doing agriculture in a sustainable way in India, in Madhya Pradesh based on learning's from organic movements outside India, through their association with IFOAM. They have range of members from farmers, bureaucrats, other NGO's, private organizations/trusts, not-for-profit organizations and retired

agricultural scientists. The activities of this PA mostly help farmers with local organic production. Mostly serving scientists are not part of this movement and wisdom for taking this path comes only after they are out of the research system. This PA was formed due to personal push (Dr. T.G.K. Menon) who is member in the State S&T council (actually approved three projects on organic farming), board member ICAR institutes (who hardly get influenced) member of State agricultural university Board, also serve as advisor to State government on water-shed management (resigned after they were not successful in influencing). Their presence in these institutions could not influence the State government to form a policy in favour of organic farming, and the State till now does not have a policy for OA. This PA has office bearers and members who influenced by Gandhian philosophy got into OA and are now reaching out to farmers need mostly for catering to the domestic certification, by charging very little fee (Rs. 24/acres), they do not seek funding from outside or government funding and run mostly on membership fees now. But they are well connected to various local NGO's, like, Krishna chetanya group. Recently, they were able to facilitate formation of farming association by bringing together, practitioners/farmers in OA. They do not trust funding from Central government (NCOF) for OA, which they think is mostly for biofertilizers or other inputs production, they believe that funds are not being distributing evenly. This PA is still existing in small but continue to cater to the location specific niche of small farmers mostly in MP, and has not grown much physically but their interactions with farmers have steered them to form farmers associations by coming together. However, many people dispersed from this organization to form other influential organizations like, UCOB, which whole handedly pushed the agenda for organic farming for Uttaranchal State¹³.

Figure 2: PA links with other actors in the OA innovation system



All India Organic and Biodynamic Farming Association (AIOBFA)

¹³ Binita Shah, personal communication

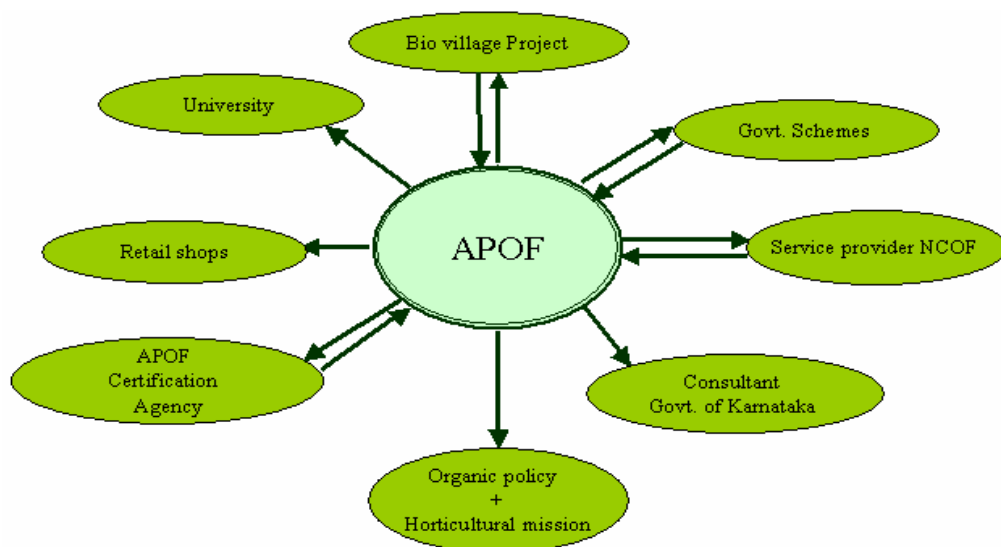
Association for Promotion of Organic Farming (APOF) formation was initiated in 1997 by a research scientist¹⁴ from University of Agricultural Sciences, Bangalore, who was influenced by his experiences on natural farming mainly from Japan and getting associated with IFOAM South Asia Conference. This was well before the State or central government had any plan for OA in India. Typically composed of members, APOF has very few office bearers actually. Members are from diverse background; whosoever is interested to the cause of organic farming was welcomed to be member by paying membership fee. APOF by and large has regional presence with more work in Karnataka and modest speck in Andhra Pradesh and Tamil Nadu with members from other part of India only for the namesake. APOF's activities generally included making members, organizing workshops/seminars/trainings etc. APOF with time have stopped encouraging new memberships as they see them as hindrance. This is to stop making members just for the sake of it, and not contributing to the cause and only becoming members for questioning the PA activities. As a result they have become very careful with new memberships now. APOF being part of the empowered committee on OA participated in the process of the establishment of National Centre for Organic farming (NCOF)¹⁵. APOF was also able to convince the State government of Karnataka, to form a policy in favour of organic farming. The beginning in OA was made through biovillage project in one of the 27 districts in Karnataka. APOF used this concept to operationalize OA, by acting as an anchor organization and involving a farmer (identifying the farmer with leadership qualities), a site officer from the Department of Agriculture and a local NGO. These three operate together and APOF receives money from the State government for facilitating this process. Initially, APOF found it hard to classify NGO's at the local level as these NGO's were not much conversant with OA principles and the majority NGO's were not paying attention to agriculture. However, after working for many years now PA has now build up linkages with local NGO's. Other major activities included, publication of literature for farmers in local languages, training, capacity building of farmers, demonstration, etc. all for the farmers. APOF has a strong association with the government of Karnataka mainly as consultant (individual credentials working). This is one of their main tasks and is mostly due to the trust factor by and large in the individual capacity and long association with the university, which the other private organizations/NGO's do not enjoy. As APOF have been a regular service provider to NCOF also, they are relatively satisfied with Central governments programs but find them very disengaged from other agricultural policies and institutions. Mostly running on memberships and projects funded by the government, APOF helps farmers by facilitating them in for organic conversion, inspection of certification, supplies if needed and mainly making them appreciate and help them to generate their own inputs and becoming independent of external sources of inputs. This also helps in making them self-reliant by popularizing integrated farming system and not merely organic agriculture production. APOF is also now trying to link farmers to the retail shops or other certified outlets. They refrain from getting directly involved with this linking process, as they believe if they do that it will not be justified for the mandate of organization. APOF is also connected to

¹⁴ Prof. G.K. Veeresh, personal communication.

¹⁵ Money allocated by the planning commission (around 100 crores) to the fertilizers and pesticides section of the Department of agriculture led to the formation of National institute of Biofertilizers, which was later converted into NCOF to operationalize projects on organic farming.

around 35 organic shops. APOF has also tried to link up with the traders but unfortunately there is lack of continuous supply of organic and lack of awareness for organic labeling by consumers they were not able to fetch stable market. APOF is working together with ICCOA (as board of Director), with Institute for Horticultural development, with government of Karnataka, Vijay Mallya group research foundation for organic vegetables, organic commercial retail stores etc. APOF serves as an expert to these organizations, but most of these linkages are individual capacity and need not represent APOF participation. APOF also helps farmers get subsidies or other schemes information/benefits instigated by the Department of Agriculture, for example, subsidy on vermicomposting by the Department of Agriculture at the time of conversion, by getting drums for making liquid manure, facilitating sharing the drum, knowledge about local plant protection material (refrain from helping in cash), linking with forest department in getting samplings, help them in buying the saplings (like, money given from their project where they have to pay a very significant amount to the forest Department for plantations) help farmers in procuring green manuring seeds, which they return the next year after the crop.

Figure 3.: APOF interactions with diverse actors in the OAIS



Association for Promotion of Organic Farming (APOF)

OASIS formation in 2000 was also inspired by some of the members of IFOAM and all like-minded qualified professionals- agricultural scientists of different fields. They started by putting together their own personal resources and only later they were able to raise resources. The main aim was to help farmers and serve a forum for the promotion of OA among the farmers /growers by providing integrated services by technical experts. They assist farmers in production, processing and marketing of organic farm produces and products at national and international level, help them with problems /constraints, awareness among the public about organic farm produces and products, imparting

training on management of OA practices, inputs, processing of produce and promotion of marketing. This is done mainly by publishing bimonthly newsletter in local language, farm consultancy, forming associate members, trainings for farmers, input producers and food processors creating awareness in public through meetings and other media, arranging exhibitions/seminars/conferences, documentation of Organic farming, compilation, writing and publication of packages of practices for crop production. Their involvement in village development projects and other agricultural schemes was important like, TIFAC Vision 2020 Mission Agricultural; Project at Kanchepuram, aiding in marketing of organic produces and products. Trainings for input producers, capacity building of farmers, farmers field schools for teaching plant protection, organic fairs where OF farmers, traders are made to link up, etc have been mostly funded by Central government NCOF. Besides they have linkages with ICCOA, IFOAM, Indocert from Kerala, Biogreen foundation (NGO from Kerala, they have contacts with university, which serves as good learning place for vermicomposting. They have been able to influence university, and OA has been included in the Agronomy course, but no course exclusively for organic farming. However, a strong interactive or ongoing relationship with the research system is lacking. Also they have not been able to push State government support or policy for organic farming. They do not push for more funding as they find it difficult to handle, they do not want to go very big to loose track also with their focus on local situations/problems. They find with the norms of OA difficult to convince the farmers and are working towards the need for changes in organic standards structure. OASIS's main focus is marketing which they feel is the most important component to be emphasized. They feel that it should be scientifically handled; lack of organic policy are some of the concerns where government has not been successful. They are into preparation of policy paper for Tamil Nadu basically learning from Maharashtra, Karnataka. They have come out with books/reports/other local publications like, packages of practices and organic fairs –bringing other products also through their networks, with Biogreen foundations in Kerala, Central Plantation Crops Research Institute (CPCRI) an active member, meeting Kerala on spice networking of NGO's and training them etc.

Looking through the origin, functions and presence of linkages among the above PAs the ***first innovation system feature: Presence /association of several organizations/actors with these PAs in the OA innovation system was revealed.*** These actors range from the farmers, input producers, traders, and retailers etc. bringing different sources of knowledge and expertise. However, they are disconnected with the expertise that generates technologies (research system), often so they unable to persuade them to take up technological problems they face in the farmer fields. These interactions are mostly related to marketing of organic products and were initiated to help farmers with alternative form of agriculture to begin with, but now these interactions have emerged to make use of the schemes/funds under various institutions and organizations created by several States as well as Central government initiatives to boost organic production in the country. The interaction of PAs with other actors in the OA innovation system is mostly similar and often complementary to the activities being carried out by already established NGO' and private organizations which were already playing their roles in the organic agriculture often catering to the global markets for organic produce. Now slowly with rising competition and imitating from other organizations PAs interactions or

partnerships with these diverse actors (Stakeholders) non-research actors are ranging from farmers, to traders, retailers, certification agencies, and specifically government departments etc. These interactions involved sharing the common concerns, ways to tackle the problems, sharing experts for training and capacity building initiatives, participations in the workshops /seminars, writing for their publications etc. Often they are representing as board members in some of the organizations involved in OA innovation system. As they come from research system background they are often treated as experts for various consultations by these diverse set of actors in the innovation system. But, they hardly go back to the research system for updating or their field level inputs are hardly recognized or taken up by the research system. Generally only a few individual professionals from these PAs become part of the State level/Central or other stakeholders in OA, and State do not recognize PAs as group of experts, which is looked upon for advice. These diverse actors become linked to the PAs often by becoming member of the PAs. These PAs have not taken a lead to transform either OA or the sciences that can cater to OA. Seemingly the old-boys network of retired professionals with existing public sector schemes/ Departments is the major driving force that keeps these PAs going. They appear to be organizations just created/formed to make use of the funding available from the government and often composed of a retired horde of scientist they also do not want to go very far with their efforts, afraid of their physical inabilities for reaching out to the stakeholders more aggressively. But they do lay emphasis on marketing like, they see how contract farming could help in taking the product to the market, trying to get connected with Reliance group, who may like to have a shelf on organic farming products. OASIS is also connected to the horticultural crop mission of the State. In Tamil Nadu there is strong lobby for fertilizers not so keen on OA (communication with Dr. Veeresh). OASIS is trying hard to push OA into policy level debates. GOI issues/ regulations are not mandatory to be followed and are voluntary in nature. OASIS is also linked to Green foundation an NGO with on farm conservation of indigenous seed varieties of millets, paddy, vegetables and oilseeds. PAs along with other key organizations have played an important role by working and interacting with wide range/broad spectrum of actors, the actors relative importance changes during the innovation process, as circumstances change and actors learn, roles can evolve, they sometimes have often played multiple roles (sources of knowledge, seekers of knowledge, coordinators of links between others). PAs have actually formed in response to changing policies, schemes for OA markets. Exploring the first feature reveals that although there are presence of diverse actors in the innovation system the interactions are mostly based on the personal credibility and expertise and need not represent that of an organization. Forming a PA just gives them space, anchor or affiliation. As most of these PAs are still managed by one or very few professional individuals with little administrative support and over the years they have not expanded much. They have a targeted mandate of working for the farmers in a very focused and small manner.

Second feature of these PAs is that they seem to be focusing on both technological as well as institutional changes. OA is considered to be less focused on technologies and more on the processes that make the product organic. PAs in OAIS have also focused more on the institutional innovations. With the changing needs of the innovation system PAs are slowly recognizing the need to cultivate the capacity to respond to emerging challenges and opportunities and worked on various institutional and technological

innovations for OA. Most of these innovations have come up in response to the need or problems faced by the sector or innovation system. PAs serving as a platform for different actors form need based linkages with these actors, it also allowed these actors to form linkages among themselves which is seen as a major institutional change in response to the presence of diversity of actors and often playing complementary roles in the OA like, they tend to work together sometimes in response to requirement of the funding agencies also. Through these linkages and with little inputs from the research system PAs have helped farmers in getting access to the technological innovations ranging from the organic inputs, packages of organic practices for specific crops to suit local specific situations.

Table 3. Technological and institutional innovations enabled by the PAs- some illustrations.

Innovations	Linkage/support
<p><i>Technological innovations</i></p> <p>Organic input production</p> <p>Biofertilizers units</p> <p>Vermiculture hatcheries</p> <p>Compost units</p> <p>Training programmes</p> <p>For certification and inspection agencies and service provider</p> <p>Extension officers/field /functionaries</p> <p>Packages of practices for location specific crops... local varieties</p>	<p>PAs beginning by propagating with an holistic approach (to produce everything on field itself) now they help service provider with funding from National Project on organic farming or some State department /or biovillages projects in these training on production and quality control of these units themselves or linking with the expert organizations (like, INORA, ICCOA, MOFF, etc.) or individuals in the field. Buy back arrangement from local vermicompost farms,</p> <p>Trained local youth to handle algae collection/ rhizobial inoculation. Trained inspectors for inspection and certification of OA and produce. Also trained State department personal in OA.</p> <p>Helping/advising other organizations to come up with POPs, also sometimes seeking for local crop varieties/seeds from the universities/other organizations to help farmers in organic production supported by NCOF, FAO etc.</p> <p>Seminars on various issues related to OA like on organic inputs, operational methodologies and packages of practices in OA organized by APOF.</p>
<p><i>Institutional innovations</i></p> <p>Providing a common platform to a variety of stakeholders ranging from government officials to NGO's to private agencies</p> <p>Farmers study tours</p> <p>Formation of separate organization to help with domestic certification</p> <p>New ways of certification for small farmers- Group certification for the small farmers called PGS- Participatory Guarantee System for organic farm certification.</p>	<p>This is mainly done by organizing seminars/workshops and inviting various stakeholders to express, share and network with each other. PAs play the role of facilitators. Trying to Link them to market. IFOAM is the main supporter.</p> <p>As organic production and certification cannot go together or institutionalized in the same organization, most PAs have come out with their own certification agencies like, APOF has led to Apof certification agency (ACA), OASIS has formed Integrated Services for Certification of Organic Products (ISCOP). This has not only helped to facilitate faster and smoother certification but also cost effective as compared to certification agencies of international repute.</p> <p>APEDA is the main organization supporting this.</p>

Source: Interactions with various office bearers at APOF, OASIS, ISCOF, NCOF etc.

AIOBFA, APOF, OASIS all began with an emphasis to reduce or minimize the external inputs (prepared elsewhere), and produce everything on the field thus boosting the “self reliance” motto among the farmers. This axiom mostly look for locally generated inputs or cheaper locally generated and available plant protection technologies and less

dependence on outside with more stress on growing for themselves then thinking of selling it outside. These PAs in their own way tried to address the technological and other constraints that farmers faced in their fields, with more focus on small farmers. AIOBFA and APOF played an important role in popularizing the local varieties and products with value addition at local level. Helping farmers in marketing, they are of the view that farmers do not want subsidies they want proper price for their produce. With less dependence on the middleman that lead to whole range of related social issues like, suicides, tensions etc. Technological innovations have been based on their experiences at the field level with little help from the research system.

Major institutional innovation among these PAs is formation of another organization –a certifying agency that is generally a group of professionals who separate out of the PAs. This has come up in response to the high and varying cost of the certifying agencies which small farmers find difficult to bear and also to make the presence of Indian certifying agencies (which are generally of foreign origin). These PAs are working on new ways of group certification that mainly include institutionalizing Participatory Guarantee System (PGS) and Internal Control System (ICS) for domestic needs, which helps to bring together farmers for group certification and also reduce the cost of certifications. Certification of the organic produce is the major challenge as most the certification agencies accredited by the government are private and often resort to international high standards, which the small farmers find difficult to adhere to. To make the certification process easy they have formed a certification agency, by and large in response to the growing cost of certification. PAs have been able to loud the farmers voice and have come out with these institutional changes in the procedures by facilitating the introduction of group certification for the small farmers called for organic farm certification. All these PAs have been able to institutionalize formation of small groups of organic farmers, and help them maintain simple, genuine and honest records (ICS) and get the farm certification under PGS. This has helped them in save high cost of certification which otherwise be required by outside certification agencies and provides an organic label that is acceptable at the domestic level. To facilitate this process even more further APOF and OASIS have formed separate sister organizations as certification agencies, namely APOF certification Agency (ACA) and Indian Society for certification of Organic products (ISCOP). PAs have been able to institutionalize them as independent nationally operated non-profit organizations for conducting inspections and issuing certification for organic production techniques to cover organic inputs and outputs. They have strong technical cooperation with their sister organizations from where they have originated. Thus, to tackle the high cost of certification these PAs have been able to bring some institutional changes in the form of separate Certification agencies to facilitate easier and cheaper certification. These certification agencies conform to the National Standard for Organic products, notified under National Programme on Organic Production (NPOP) by APEDA (main accreditation agency of Government of India).

This institutional change was also in response to the norm that organic production and certification cannot go together (it tend to be bias) and they formed a certification agency, which is a separate body. Their functions are different but they do share resources/information and are linked to each other in their work related to OA. Despite

coming up with these separate domestic certification agencies they lack the ability to compete with the international standards. They do not claim high regards but exporters are often suspicious on the reliability of their products. Although they have been approved by APEDA to certification at par with other agencies in the country, they do not seem to have as yet put down stringent procedures often constrained by the low cost of their certification procedures. The farmers who grow for export will go for other more established certification, and approach them only for the certification of domestic products (which may be cheaper but do not fetch high price/demand in the international market). Certification agencies have a very different operation to do (they often call them selves as company and the associations as an NGO). In addition to facilitation of organic production and certification, PAs play a major role of providing a platform for all the stakeholders involved in the organic agricultural innovation system.

Third feature of innovation systems feature reveals a mixture of both rigidity and evidence of learning and behavioral changes in these PAs. These professionals (APOF, and OASIS) were mostly part of the research system that was dominated by input based chemical agriculture with little flexibility to reach out or communicate with other non-research actors. These professionals after becoming part of the PA (they seldom become active part of PAs as part of the research system) have learned to communicate with the farmers, NGO's and government departments to help in OA innovations. This is in response to the varied demands of the innovation system that is more knowledge based and learning mostly requires learning about the ways and the processes that would help the innovation system. As most of the professionals come from the research system, they had experience of working with development of various technologies, but almost remained isolated from the societal needs. They have learned to build up linkages with various stakeholders, where ultimate aim is practically to help the farmer. PAs give them a platform to make use of their professional expertise and linking this to social needs. In this process they get more close to the societal needs and learn to communicate with range of other actors ranging from farmers, /NGO's, government departments, but in the process they often see themselves as professional experts/ultimate authority and hardly go back to the research system for their inputs/feedback and even if they go to the research system for advice research system is busy doing its isolated and ritualistic research and is hardly equipped or flexible to cater to these emerging needs of OA.

The attitudes and practices of PAs are evolving but slowly, they are also trying to become major actors in the OAIS but are held back by some of their older attitudes and practices which they still hold of for example, not thinking beyond public sector for the sources of funding. As they enjoy the trust of government departments and get funded easily (Government has more faith in these PAs, which have originated from the public sector system), they hardly go out and link with other actors to seek other funding sources. They are happy /contented with the present way of doing, they do not want to go big, they are hurdled by the staff, field workers etc. Some of them are trying to link with retailers and farmers by imitating or learning from other actors, but somehow cannot sustain it for long due to lack of funds, human resources. As most of them are retired scientists, not many young professionals are involved. So they resist risk taking. They feel insecure and so are unable to attract young professionals and have money only for sustenance. They resent going big as most of them are retired, old (drawing their secured

pensions with little incentive of making money or struggling to make their living) with physical disabilities as well as restraining from taking up or handling big responsibilities. The absence of women in all these associations (even in their boards or in a namesake advisory capacity) is also in keeping with the cultural practices that these male 'professionals' had during their scientific career. Although they have range of interactions with diverse organizations/actors their interactions are either through members they have, or working together or being a part of their Board meetings, but linkages are mostly in individual capacity. Fear of expansion may be due to the fear of losing control if they take in more people, qualified professionals or even merge to expand operations. Most of them even did not have a proper office and many times they operate from home.

These PAs do not plan or aspire to go big (physically as well as financially) as they do not have enough staff to support, they are scared to do that. These PAs are still dominated by retired professionals and lacks young professional, who fear getting into this cause of using science for societal cause (for this research and education system is to be blamed). They have not got away with that fear and conventional way of working and taking up risks which they inherit from their earlier system like, at APOF the professionals do not get salaries only get little administrative support, and for travel etc. As most of them are retired scientists they have their pensions to support them, but this brings the future of organization at stake, they do not have any future vision for their respective PAs. Future of PAs depends upon the personal commitment of the person taking over the charge next, it is main reason for their slow growth and low visibility, by doing this actually they shun away from the accountabilities as they (APOF) even do. They often do not documented their learnings in a professional publications. APOF has been working like this, over these many years (since 1998) and it has been like this with little expansion due to personal commitment and its future course will depend on the next successor. They are happy to maintain themselves with Biovillage project which gets the about Rs.50-60, 000 for the maintenance of office, communication and supporting staff and field assistant.

Despite all that these rigidities associated with PAs they have acted as catalyst organizations and have helped organizations change their attitude or behaviour. Like, earlier State Department of Agriculture in Karnataka was totally against OA but slowly they are learning and recognizing its, even the farmers are getting interested it. OA is seen more a way of living with social value. Their attitudes and thinking have changes working for the farmers They find policies of state contradictory with on one side criticizing suicides and on other side giving them subsidies. OA can be one of the pathways to work towards giving them a means of sustainable livelihood. For example by popularizing local crops like, millets, which have been mostly dominated by policies favoring rice and wheat only as a way for local food security. Local foods /crops will help sustenance of these farmers. OA they believe helps farmers' agriculture as a way of life and not as commercial activity. PAs see themselves as voluntary workers who have come to terms with the mind set of farmers. Farmers do not sometime distinguish between PAs and extension persons from the department of agriculture, and as often PAs do not give anything in cash/kind they are seen with suspicion. So these PAs have to fight with the general mindset of people, the general input intensive approach. And as farmer

become self-confident and independent after 2-3 years, they consider it as their major achievement. PAs are against the concept of subsidies and they emphasize capacity building making farmers to tackle on their own. But they are aware this is a slow process and will not get done overnight. Main approach is giving minimum support to the farmer. This change in PAs perception is a major change. Lack of both self-evaluation and no demand for external evaluation by the State government from which it derives its main funding is a major impediment for them to learn and change and is as prevalent in other organizations from research or extension of the agricultural innovation system in India.

The fourth feature of innovation systems that is creating or enabling policy and institutional environment reveals that PAs have now learned the know-how of the various processes, institutions, their working related to OA. They know whom or which department to contact or seek funding for various kinds of operations related to OA. They have been able to raise the issues related to OA through various seminars/workshops. They are also aware on how to create institutional innovations for small farmers to take up OA or any other linked activity like biofertilizers production, vermicomposting or training or certification of inputs. They understand the certification processes and are aware of the quality and standards (not just of the produce but of the soil and water resources) among small farmers – this is an enabling institutional capacity that can go a long way in India's SPS (Sanitary and phytosanitary) standards in international trade, in healthy and safe ecosystem, etc. Due to their earlier links with the research system that gets them to trust by domestic funding they play an important role in creation of social capital by playing a linking role enabling trust based relationships – value-based production and consumption systems. As PAs in OA have been mostly state supported by central/state government. These PAs have mostly taken up OA as a local solution taking up state specific agenda and were able to push organic policy for the State and in some cases central policy also. Yet there are much more improvements needed in enabling environment.

5. Hybrid seeds innovation system and its innovation potential

Hybrid seeds innovation in India was major part of the technology package (High yielding varieties (Hybrids) + fertilizers + irrigation) that led to green revolution in response to the growing food security needs of the country. Success of the technology package was possible only through various institutional innovations that accompany the technological innovations related to the technology package. The initial impetus in the 1960s to hybrid seeds came exclusively from the government with favorable government policies, supportive public sector R &D. Later opening up of the economy gave way to private sector participation, not only in the production but also R&D related to hybrid seeds. Hybrid seeds production is a high technology and cost effective venture. Only well organized seed companies with good scientific manpower and well-equipped research facilities can afford hybrid seed production. Private companies have actually outperformed the public research system with the conducive environment for private sector (Kataria, interview 2007). The policy reforms in Indian seed policies have shown remarkable increase in R&D effort and increase in the number of technology suppliers.

(Pray *et al.*, 2002). Currently India is producing 117,000 tonnes of hybrid seeds in crops like, Cotton, maize, millet, sorghum, paddy and sunflower on contract basis from estimated 132,333 acres generating employment of 29 million mandays on sustainable basis. Hybrid seeds of cotton contribute maximum (82.5%) in generating an impressive employment of 24 million man-days per year (Singh & Dutta, 2005). Approximately 994 tonnes of hybrid seeds are being produced in tropical vegetables from estimated 7, 957 acres leading to employment generation of 2.71 million mandays per year. So the cereals, cotton and sunflower together generate 10.7 times more employment as compared to vegetable crops through hybrid seeds production. In India the main hybrid seeds production activities are centered in southern states of Andhra Pradesh, Karnataka, Tamil Nadu and Southwestern states of Maharashtra and Gujarat.

Hybrid seeds innovation in India, although was spearheaded public sector R&D organizations in India has now been mainly taken over by the private sectors organizations. Hybrid seeds innovation system (HSIS) refers to the whole range of actors and organizations together with institutions and policies that affect their innovative behaviour. HSIS in India shows the co evolution and development of various actors, organizations, and policy changes.

5.1. Hybrid Seeds Innovation System in India: actors and institutions

Hybrid Seeds Innovation System (HSIS) in India is going through a wide range of transformation with increasing role of public & private sector with focus on biotechnology based R&D, along with changing regulatory frameworks that shape the seed research, marketing and trade in the future. From 1950-63 there was no organized seed sector, seeds available-were only locally improved varieties, farmers saved, farmer to farmer exchange (even now it constitute 68 % of total seed usage, Sahai, 1993). Hybrid seeds necessitated the need for organized production of seeds because the recommended replacement of them was hundred percent (Ministry of Agriculture, Annual Report, 1980-81) and so the demand was more persistent. Hybrid seed industry once dominated by public sector seed companies has now presence of private sector seed companies' as major actors that came along with the with easing of government regulations and implementation of new seed policy in 1988 (Table 4).

5.1.1. Evolution of Hybrid Seeds Innovation System (HSIS) in India

Evolution of the HSIS reveals the presence of diverse actors, which are located in various domains that interact with each other (Figure 5). Public sector organizations mainly ICAR, and SAUs form the principle agencies for plant breeding in the country. Hybrid seeds research began in India through All India Coordinated Crop improvement Project coordinated by ICAR along with Rockefeller Foundation in 1957, that led to improvements related to yields, disease and pest resistance, and nutritional value etc. of the crops (Table 4). This research resulted in the release of first hybrid of maize (1961)

followed by hybrids of sorghum (1962), pearl millet (1963)), Cotton and paddy.¹⁶. To keep up pace with the growing needs for hybrid seeds, and facilitate production and distribution of hybrid seeds a central production organization called National Seed Corporation (NSC) was established followed by State Farm Corporation of India (SFCI). Later National Seed Programme (NSP) funded through World Bank tried to coordinate the efforts of the NSC, SFCI, and private companies. For quality control and certification, there are 22 State Seed Certification Agencies (SSCAs) and 101 State Seed Testing Laboratories (SSTLs). Public sector breeder seeds are available free of charge to private seed companies, which are available through All India Coordinated trials annual workshops providing access to private sector seed companies (Rao, 2004).

With rapid developments in agricultural technologies and liberalized national seed policies private sector started investing in hybrid seed research and development. Private sector R&D is now talking up the lead with major share in the annual sales of hybrid seeds. Private sector started entered the seed industry in 1970s with a major mandate to carry the research from public sector to the farmers in supplying good quality hybrid seeds. In mid 1980s the private seed industry started working on in-house research and breeding and releasing the products with better yields to the farmers. However, with the release of seed policy of 1988, the MNC's and their products started coming to India, with many of them establishing a joint venture projects with Indian Companies. The liberalization of vegetable seed imports attracted many MNC's and the farmers could buy best of the vegetable hybrid seeds available anywhere in the world (Kataria, 2005).

Table 4. Actors and institutions in the Hybrid seeds innovation system in India**

Sl.No	Event intervention	Actors involved	International /domestic drivers
1. Late 1950s	-No organized seed industry Coordinated maize improvement programme (All Indian coordinated Crop improvement Project) (1957)	Indian Council of Agricultural Research (ICAR) State Governments	Rockefeller Foundation (USA) International Agricultural Research System—through Supply of high responsive genetic material, equipment, training to Indian scientists, assistance in design, conduct, monitoring of breeding programs/yield trails. Met all recurring expenses, appointment of staff, work plan and coordination of work among all participant
1960s	First maize hybrids adapted to Indian conditions released, 1961. Hybrids for Sorghum(1962), pearl millet(1963), Cotton(1968) were released Hybrid seeds imported, Green revolution, need for organized seed sector	Domination of public sector ICAR, SAU's Department of Agriculture, Ministry of Agriculture, State Departments of Agriculture	

	<p>Foundation seed production, processing, storage, marketing, distribution, quality control, seed certification</p> <p>Production of seeds in States</p> <p>Seed Act, 1966*-provided system of quality control through independent State seed Certification agencies</p> <p>National Seeds Programme (NSP), 1967 Constitution of seed review team (1968)</p>	<p>National Seed Corporation (NSC), 1963 State Farm Corporation of India (SFCI), 1969 State Seed Corporations (SSCs)</p> <p>NSC, SFCI, Private companies</p>	<p>World bank supported</p>
1970s	<p>Development of first Hybrid Cotton, 1971</p> <p>National commission on Agriculture, 1976</p> <p>National Seeds Project I (1977-78) National Seeds Project II (1979-80)</p> <p>National Seeds Project III (1989-90)</p>	<p>ICAR, SAU's through 14 Centres on Seed Technology research +breeder Seed production Centres</p> <p>ICAR, SAU's, Department of Agriculture, Seeds Corporations, Seed certification agencies +Private seed industry</p>	<p>World bank supported</p>
1980s	<p>Granting of permission to MRTP/FERA companies for investment in Seed Sector (1987)- This allowed large and small companies to invest paving way for MNC's</p> <p>"New Policy" on seed development (1988) - allowed import of coarse cereals, pulses and oilseeds</p> <p>Plants, Fruits and Seeds Order, 1989- allowed import of seed/planting material Expert group on seeds, 1989</p> <p>Research in Rice hybrids, 1989</p> <p>Research on oilseeds hybrids</p> <p>Vegetable hybrids</p>	<p>Indian private seeds enterprises</p> <p>Multinational Companies (MNCs)</p> <p>Foreign companies subsidiaries</p> <p>ICAR, IRRI, CRRI, IARI</p> <p>ICAR, IARI, TERI</p> <p>ICAR, Indian Institute for Horticultural Research (IIHR)</p>	<p>Emergence of large Indian private seed companies, like Hindustan lever, ITC, JK, Rallis, Sandoz before they could develop their own technical capability.</p> <p>Foreign seed companies entered into joint ventures with already existing Indian Companies or open subsidiaries like, Pioneer, PGS, Cargill.</p> <p>sowing and planting is permitted without license</p> <p>UNDP—financial and technical support</p> <p>Technology mission of Oilseeds, GOI</p> <p>All India Coordinated vegetable Improvement Project, (ICAR)</p>
1990s	<p>New Industrial policy 1991-with seed industry identified as " high priority industry"</p> <p>Seeds policy review group (1997)</p>	<p>Liberalized imports of vegetables and flower seeds in general and seeds of other commodities -encouraged MNCs to enter seed business. ... more than 24 companies initiated R&D activities and commitments for investments in response to this policy initiative.</p>	<p>World globalization drive...</p> <p>Domestic Seed industry further liberalized, Certified high yielding hybrid seeds and synthetic seeds and certified high yielding plantlets developed through plant tissue culture has been put under the list of industries, for automatic approval of foreign technology agreements and for 51% foreign equity</p>

	Hybrid for Paddy released Farmers movements against hybrids Several campaigns on saving the seeds	Navdanya, several local organizations related to conservation movements	approvals and it has been taken out of the requirement of licensing.
2000 and later	Protection of Plant Varieties and farmers Rights Act, 2001 National Seed policy, 2002 Assistance for boosting seed production in private sector (credit linked assistance (@25%) with maximum limit of Rs.10 lakhs. Seed Bill, 2004 National Seed Research and Training Centre at Varanasi, 2007 Central sectors scheme are Quality Control Arrangements on Seeds, Transport subsidy on movement of seeds to North-East and other hilly areas, Establishment and Maintenance of Seed Bank, Seed Village Scheme, Assistance for creation of infrastructure facilities, Assistance for boosting seed production in private sector, Human Resources Development, Assistance for Seed Export, Propagation of application of biotechnology in agriculture, Promotion of use of hybrid seeds of rice and evaluation/review.	GOI, MOA NSC as implementing agency Private companies, individual entrepreneurs, self help groups, seed cooperatives Nationalized banks and National Cooperative Development Cooperation (NCDC) State departments of Agriculture, SAU's, KVKs, SSCs, NSC, SFCI, SSCAs, Department of Seeds certification... one of them is identified and authorized locally. Private companies, individual entrepreneurs, self help groups, seed cooperatives MOA, GOI, NSC	Tenth plan proposed to boost private sector National Seed policy recognized greater role for the private sector in the functioning of seeds industry Agricultural Department through its seeds division have launched this Central Sector Scheme "Development and strengthening of Infrastructure facilities for Production and Distribution of Quality seeds" with an outlay of Rs.159 crore for the Tenth Plan.

Source: Compiled from Pandey, 1994, Rao, 2004, Sharma, SAI, 2005, Rai, 2004.

*Seed in Indian Agriculture are governed by nearly 30 legislations—the seeds act 1966, Commodity Act, 1955, Biological Diversity Act, 2002, PPV&FR Act, 2001, Patents amendment Act, 2005, Environment protection Act, 1986--so on. all of them have not been explored in detail.

**The table intends to give only a broad picture and presents only some and not all-important landmarks related to Hybrid seed sector in India.

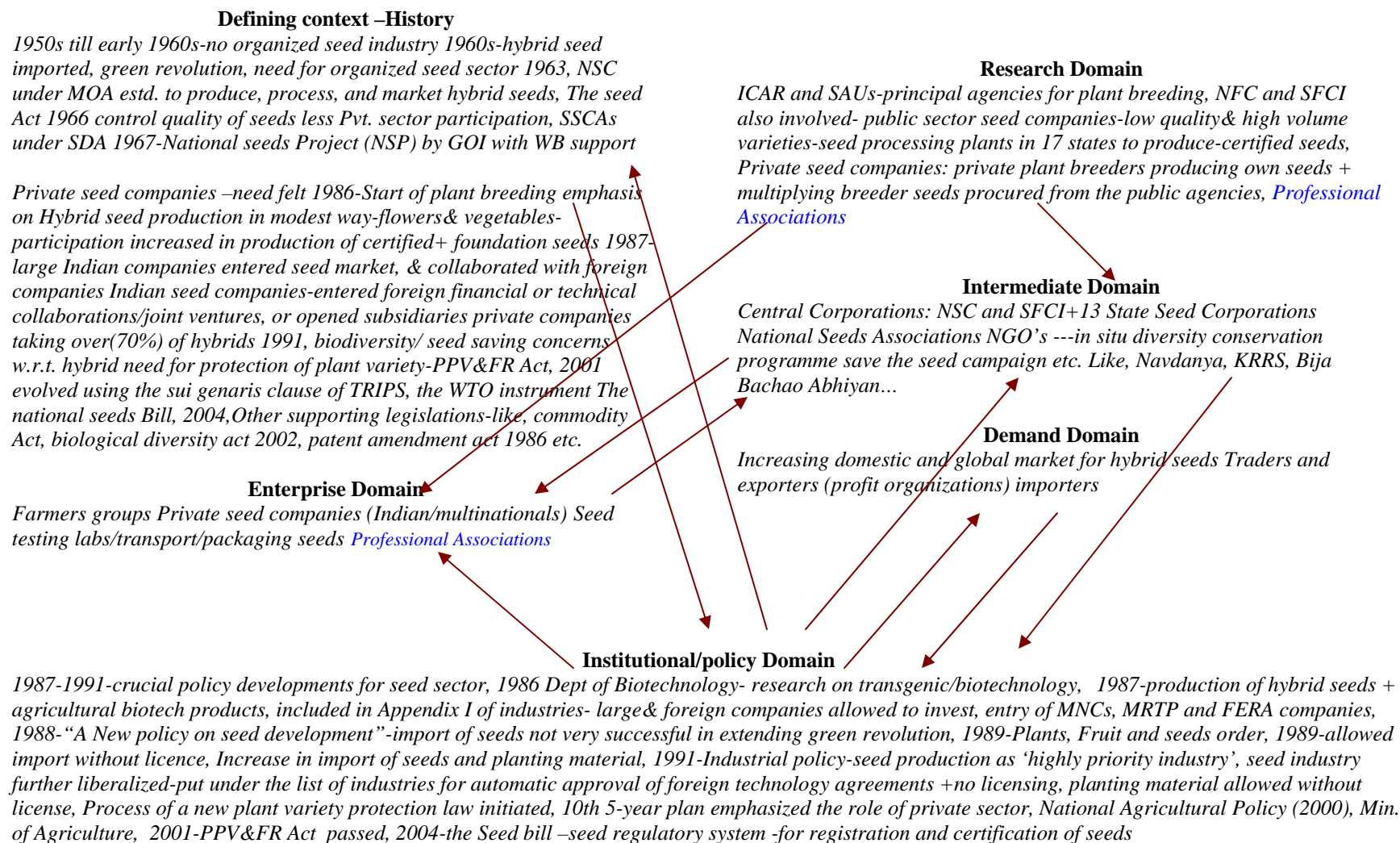
Until 1990 most hybrids used by farmers were bred through public research system. However new seed policy of 1988 and later reforms facilitated the entry of large domestic and multinational seed companies who developed and commercialized genetically superior hybrids. Major share of hybrid seeds in cereals and also in vegetables are from private sector after 1990s. As the activity of the private seed companies was not restricted to a central facility as the government research station, private companies have outperformed the public research system. While the public sector has developed only 29F1 hybrid varieties with less than 1% share, the private sector is marketing more than 1000 hybrid varieties of 14 vegetable crops. Seeds replacement in vegetable crops is more than 80% as compared to 10% in other food crops (Kataria, 2005). After the new Policy for seed Development enacted in 1988, subsequent 1991 Industrial policy identified seed production as a priority investment further and facilitated multinationals' entry into the seed market. Indian seed sector thus saw a lot of policy development that encouraged investment from domestic and multinational seed companies with increasing numbers of domestic companies and multinationals by 1998 with their own hybrid breeding programs (IBRD, 2006). The roles of public and private sectors also emphasized by the seed policy review group (1997) along with the need for a National Seeds Policy and prompted suitable provisions relevant to the public and private sectors. These attempts ultimately culminated in the shape of the national seeds policy 2002 identifying thrust areas and enlisting specific policies both for private and public sectors (Figure 4).

Public sector organizations and private research grew in isolation and interface was confined only to the private sectors' access to public germplasm, participation in workshops, testing of private hybrids in project trials. However since 1999 focus has shifted to institutionalize the interface system-wise through frequent dialogue within various stakeholders to build mutual trust, sharing research resources, evolving linkages etc. (Kapur Arvind, 2005). The private sector has started to play a significant role in the production and distribution of seeds. However, the organized seed sector particularly for food crops cereals continues to be dominated by the public sector.

Declining public funding for agricultural research is pressurizing the public sector to perform better and also seek partnerships or involvement of the private sector in the HSIS. Public-private partnership is now being encouraged with the government-owned National Seed Corporation (NSC) has joined hands with multinational firm Monsanto India Ltd (MIL), to market its hybrid corn seed. The company signed a memorandum of understanding (MoU) early this month with MIL to market and distribute 200 tonnes of hybrid corn seed this year¹⁷. International Crops Research Institute for the Semi-Arid Crops (ICRISAT) have gone ahead and partnered with the private sector for hybrids seeds production. Thirteen seed companies are now involved with the hybrid sorghum programme and 16 with the pearl millet breeding programme that ICRISAT began in 2000. Private sector companies based in India initially relied on ICRISAT-bred hybrid parents, and gradually developed their own R&D capabilities, and become a major source conduit for large-scale farm level adoption of hybrids derived from ICRISAT-bred hybrid parents and /or their derivatives private sector companies.

¹⁷ (<http://www.seedquest.com/News/releases/2007/october/20768.htm>).

Figure 4: Hybrid Seeds innovation system: a domain map



ICRISAT used these private seed companies as a complementary expertise, as they are closer to seed merchants and farmers, so have better integrated perceptions of farmers' preferences. Also this prompted ICRISAT to use these private seed companies as a funding source, instead of passive recipient of ICRISAT bred parental lines-----leading to initiation of ICRISAT-Private companies Hybrid Parent Research Consortia for Sorghum and Millet. This concept of consortium approach for public-private partnership research is a novel institutional building approach, receiving wide appreciation from Private seed companies as well as CGIAR (Gowda, Reddy *et al.*, 2004).

Among the range of actors/organizations discussed in HSIS, PAs emerged as one of the actors along with the evolution of private sector organizations in the Hybrid seeds sector. PAs occupy a position in the enterprise domain along with the private seed companies but their mandate is not directly getting into hybrids seeds production but facilitating the process by becoming a link between the public and private sector when have often led divergent paths have been explored as innovation systems actors for their roles in the HSIS. In the new developments and policies to boost private-public partnerships, role of PAs as interface organizations becomes even more important. Often government regulations and procedures are seen to delay and obstruct seeds trade in India, PAs play the role of facilitating the organizations mainly private ones to help with these procedures. Some of these constraints are cumbersome import-export procedures, seed certification and testing standards (SAI, 2005). HSIS has been explored in the above sector by locating PAs as innovation system actors through their linkages with other actors in the innovation system. PAs in HSIS have also been explored through four essential features of the innovation system features.

5.2. Professional Associations in Hybrid seeds sector: role they play

Professional Associations in hybrid seeds sector emerged to favor the seed industry and could be called as industry associations. PAs in HSIS are often supported/funded by national level private multinational seed companies. This makes them a mouthpiece of seed industry. PAs dealing with hybrid seeds are old and were formed and evolved along with the private seed industry in the country. These PAs mainly emerged in 1980s when the private sectors got a real boost in the country in response to the need felt of the industry and favorable government policies in favor of the seed sector. PAs looked for their role as facilitators to serve farmers by supplying hybrid seeds in cereals, oilseeds, fibre crops and vegetables through their linkages and support to the seed industry. Although public sector is also opening up slowly, but the major boost to the hybrid seeds production was only possible only through private sector, which was strongly supported by the PAs. They play the major role of representing the seeds industry and pushing the regulatory reforms and other assistance they need to expand the domestic as well as international seed sales.

5.3. Exploring features of innovation processes and systems

PAs in the hybrid seeds innovations system have interactions with several actors and they act as major sources of knowledge and expertise. Seed Association of India (SAI) was formed in 1985, as a strong body of seed entrepreneurs contributing towards the supply of high quality, high yielding seeds to Indian farmers. It is also mandated to serve small, medium and large farmers by supplying hybrid seeds in cereals, oilseeds, fiber crops and vegetables. SAI has developed into a strong body of diverse members and provide a platform to unite all firms, companies, corporations, associations, co-operatives, scientists and persons handling seeds in India to institute, promote, develop and carry on all kinds of scientific and economic research related to the production, processing and certification and distribution of and use of seeds for the purpose of increased agricultural production. PA was initiated by the ex or retired officials from the public sector organizations: the National Seeds Corporation (NSC), the major organization into seed production in India. As bulk of NSC's breeder seeds requirement is fulfilled from ICAR and State Agricultural Universities, they could reap the benefit of their earlier contacts to procure seeds for SAI.

With most of them serving as members on various committees of Government of India, Ministry of Agriculture, they helped by participating and contributing to the formulation of favorable policies for the seeds sector. They helped their members in getting breeder seed supplied by the ministry of agriculture, so form a link between the members and Government departments. This way they provide a link between members and Government departments. Through their membership and linkages with the research system they also help other members mostly from private sector organization in getting breeder seed supplied by Ministry of Agriculture, managed through their public sectors organizational members. These Private sector companies contribute to seeds in all agro-climatic zones and cover all the major crops. SAI provide a platform to interact with domestic as well as global seeds related issues by organizing annual seminars and host of international conferences like, world seed Congress and APSA conference-Asian Seed. They link up with international bodies to bring the benefits for other member companies by becoming member to them like, International seed federation, Switzerland and Asia-Pacific Seed Association, Thailand.

Besides PAs also play a role in dissemination through its publications like newsletter, organizing seminars by providing a common platform for various stakeholders related to hybrid seeds, or by participating /representing other platforms. The linkages build through seminars/workshops, trainings help to bring several organizations /actors that bring specific knowledge and experience and help apprise the members of all the policy matters and technologies in the seed trade. The seminars provide a platform for policy makers, scientists and the industry representatives to interact on certain provisions that would significantly impact the availability of seeds. It also helps to understand and make aware the stakeholders on various policy and legislative initiatives taken by the government.

With seed industry as their major sources of funds they are set to serve the seed industry. Despite the presence of various actors and an effort to link them all PAs are often lopsided in their approach and talk mostly in their favor and well connected to the private seed companies and often push their agenda only as they are funded by them also. There is no state or center support for these PAs. Most of the seeds companies are owned by the erstwhile farmers who were earlier engaged with the public or private sector seed production through contract farming (As told by Dr. Shankaran, Consultant, NSC). However they have learned to produce good quality seeds when they become part of the private seed companies where seed quality is emphasized. PAs have facilitated this process by helping these individual members in quality seed production.

SAI also work in close collaboration with other PAs present outside the formal R&D system like, Association of Seed Industry (ASI). SAI was soon followed by the formation of Indian Seed Industry Association (ISIA) and All India Crop Biotechnology Association (AICBA formed in 2003). These two PAs although exist with separate names are operational from the same office in Delhi. Both of them refer themselves as industry associations, although working for farming community is also part of their mandate for responsible use of biotechnology for modernizing agriculture and enhancing the livelihood of Indian farmers. They provide platform to the stakeholders in the hybrid seeds/crop biotechnology through various seminars/workshops/meetings. These seminars provide platform for policy makers, scientists, and the industry representatives to interact on certain provisions that would significantly, impact the availability of quality hybrid seeds. They also help in establishing transparent and fair regulatory system related to biotechnology, for encouraging public awareness about benefits of the technology. Retired bureaucrats, who on one hand are well connected to the government and leading Indian seeds companies engaged in agricultural biotechnology on the other hand head these PAs. But these PAs are poorly connected to either the research system or other science or R&D based PAs, like Indian Society of Seed Technology (ISST) or Indian Society of genetics and plant breeding (ISGPB) etc. or research system in general. Some of the science based PAs have been explored for innovation system features in the next section.

The second feature of the innovations system focuses on both technological as well as institutional changes/innovations. PAs with HSIS mostly concentrate on technological innovations in the form of breeder seeds requirement from ICAR and State Agricultural Universities building on the benefit of their earlier contacts to procure seeds for SAI. Where as, SAI often act as conduits for distribution of seeds to the private sector, ISIA and AIBA, get their R&D backing from the private sectors. They are responsible for bringing the new hybrid varieties available for the private sector, and thus act as major source of innovator seeds. For this they charge some processing fee from the seed companies. Prior to the thrust now being given to the private sector by the government PAs actually help the private sectors to make use of the opportunity and processes that would help them make use of these government schemes. PAs also battle for and represent these private sector organizations for changes in regulatory mechanisms, policies, and issues related to fake seeds etc. These four industry favouring PAs,

realizing that their voices are no more effective or are diluted by individual representations have decided to bring a major institutional change learning from their past experience. These four PAs of seed manufacturers in the country have merged to form the National Seeds Association of India (NSAI). This new body is also trying to bring the most State level associations with them to emerge as the single representative forum for India's seeds industry. They are in the process of crashing out a joint programme and nominated the office-bearers of the newly formed body. This unification they believe will lend one voice to industry issues through a common platform. They look forward to clean up the menace of spurious seeds, but they might as well push policies like increase seed replacement ratio, which may harm farmers actually.

These PAs who had their own agendas have now come together to share and decided to represent, as single ***voice is a major evidence of learning and behavioral change the third feature of innovation system.*** With increase in the Private sector R&D and less dependence of the sectors on public R&D PAs are learning to look for new directions as the problems of the industry are changing in the changing context. As the need of the industry is changing with their own R&D system they now demand more and more changes in the rules and regulation of the government to get connected to global seed market demands. Learning from these changing scenarios has also made these PAs to behave differently, to provide a greater clout and cohesion to the seeds sector and take part in creating or enabling policy and institutional environment for the seed sector.

PAs in HSIS since their establishment have worked towards pushing or enabling policy environment in favor of the seed industry, to institutionalize the new form of government –industry interaction and were mainly formed by the scientists/bureaucrat retired from the public sector to build on their older linkages with the system. They hardly have linkages either with the PAs closer to the research system or research systems such. PAs have thus not been able to promote and safeguard the overall interest of the seed sector, industry or trade in contrast to both PAs supported by formal R&D. However, it has been now realized that these PAs which are mostly industry based related to hybrid seeds have not been able to sing with one voice so they have now come with a natural partnership among themselves for a joint industry Association, which would work to raise the concerns of the growth of the seed sector, quality, market access to the seed companies. Social relevance of these initiatives do not make mark anywhere, it is not part of their agenda. This idea of one umbrella organization has been formed to effectively articulate clear and coherent policies to the stakeholders. This effort is totally isolated from formal R&D based PAs related to Hybrid seeds who are not even aware of all these happenings and are often busy raising up their own agendas/recommendation through their theme based workshops which has little takers at the policy level. Since these industry based PAs are often isolated from the science based PAs there is total lack of any feedback going the either way, from the industry to science and from science to industry. Both the PAs are busy in their own areas, professions with little socially benefiting worth.

6. Formal R&D based Professional Associations: Exploring innovation system features

PAs related to the innovations systems (OAIS &HSIS) explored in the present study have only been explored. PAs in agricultural science form important component of the R&D system. There has been proliferation of PAs in agriculture. The members are largely active/retired employees of research institutes, university departments or students and their participation in societal activities is voluntary and driven by desire to promote professional interest and personal recognition. With scientists as the members their stated objective mostly relate to the promoting the cause of their own respective scientific disciplines they belong to. In the agricultural sciences the emergence of the PAs is a relatively recent phenomenon. Their respective sciences or disciplines claim a much longer history. There has been a recent proliferation of PAs, their journals and meetings/conferences in the agricultural sciences in India. They have a mandate to further the interests of their own profession. Most of these PAs in agricultural science are supported by small grants (mostly from ICAR) that enable them to organize activities. These grants vary in amount depending upon the grade (A, B, C) they have as classified by ICAR. A Few PAs related to the OAIS and HSIS were explored using innovation system features to understand their roles in the agricultural innovation systems.

Indian Society of Soil Sciences (ISSS) have been explored for their role in the OAIS, while Indian Society of Seed Technology (ISST), Indian Society of Genetic and Plant breeding (ISCPB) have been explored for their role in HSIS. Their main activities include organizing seminars symposia, conferences, meetings etc. to enable members of their respective PA and other to interact and disseminate knowledge related to their disciplines along with bringing out their own journals that allows the space to these members to publish their work easily. These PAs mostly work in strict disciplinary modes with little integration with other disciplines with participation only in terms of members from different disciplines, which often allows them access to the annual workshops/publications and even publishing research papers. So they do have members from different disciplines but they hardly get integrated as sources of knowledge and expertise. Although they do play a role in raising the contextual issues through the seminars/conferences they organize, the recommendations from them have few takers. Although a pool of trained manpower in specific profession, they are hardly sought after for services as specialists and their participation at all levels of S&T activities from research to policy making is negligible. There are hardly any linkages among various PAs or some common projects /activities linking various PAs. They mostly work in strict disciplinary modes with little integration with other disciplines. There interactions are mostly restricted to public sector organizations (research scientists), with most of them acting as national level organizations that take up issues and overall policy issues related to the discipline. This exploration reveals lack of the presence and interaction of these PAs with diverse actors and organizations *in the respective innovation systems*.

The *second innovation system feature* reveals their concentration on new or number of technologies (technological focus) and not how many put to use or converted into

innovations. Technological focus or bringing new technologies in the form of new seeds varieties, machines/methods they carry from the research system gets translated into PAs mandate also, for example, ISST, concentrate on seed technologies in the form of number of varieties released with little interactions either with the industry or industry associations like SAI, ISIA or AIBA. There are range of issues related to OA in India related to science that could be dealt by ISSS like, organic soils yield stability, comparison of production and yields conversion problems: traditional to organic ranging, post harvest and markets hurdles from Producers groups access to processing facilities, lack of technical capacity in manufacturing, packaging, quality control, harvesting and post harvesting, producers are unorganized with little ability to operate within complex value chain, individually unable to pool resources/financing.

Their main events follow the same repetitive, ritualistic approach that has been translated from the research system with no inputs to make an impact on the either the R&D system/agricultural science or their social responsibilities. They have been funded by ICAR and continue to do so. They have neither interaction with the industry nor they are able to forcefully voice issues relevant to the congress of industry that could enable practice and utilization of their knowledge in society and the policy changes in the sector.

A sense of isolation prevails within these professional groups of researchers, scientific elites and frequent professional meetings. These are professional associations but their activities are generally confined to holding annual meetings. There are few activities among the professional bodies to catalyze the intellectual atmosphere (Krishna and Krishna, 2005). With the changing scenarios and the need to orient the sciences towards socially relevant issues there is a need to explore the role they have played in furthering the interests of their own professions and linking their disciplines to overall development goals. The goals and activities of these PAs in agricultural sciences are still guided by the overall agricultural policy goals aimed at increasing food production. Although PAs are crucial and relevant actors in an agricultural innovation system, little attention has been paid to them as one of the key actors in relation to other actors in the agricultural innovations system for development. These PAs have hardly played any role in the institutional reform in the agricultural sciences or towards the dynamic role that science can play to the society as one of the components in wider innovation systems.

7. Comparison of the PAs in the two agricultural innovation systems

Differences in the nature of PAs associated with the two agricultural innovation systems owes to the differences in the stages of evolution of the respective sectors (Organic Agriculture & Hybrid Seeds). Both are in different stages of evolution and are often considered as contradicting each other. But there are several features of these PAs that are common. In order to address how excellence in science can be enabled by the PAs, and how socially responsible science leading to innovation and development can be conducted within public R&D organizations, it is important to explore these common elements between these two PAs studied here. The comparison is also useful to highlight the diversity of contexts in which PAs operate and ways in which their roles can be strengthened.

Table 5: Comparison of the PAs in the OAIS and HSIS

Features	OAIS	HSIS
Nature of the PAs in the two agricultural innovation systems	<p>State/Central Government supported</p> <p>Local based, they have mostly emerged in response to the need of the local situations</p> <p>Represent the need of the small & marginal farmers technological needs, linkages to market/value addition and capacity building</p> <p>Evolving with the sector, working independently but linked to each other.</p>	<p>Private industry supported</p> <p>National level, they have mostly emerged to enable industry access to S&T, policy, and public actors in general</p> <p>Represent the industry and voice the policies that favour the industry, to help with business of seed companies</p> <p>Stagnated, all PAs are considering merging together to form one single PA.</p>
Context that shape PAs	OAIS is at a very nascent stage and are only beginning to develop.	HSIS is well established – and looking for new ways to evolve, especially with new Seed Bill provisions, biotechnology, etc..
Interaction with formal S&T	Hardly any, OA is more knowledge intensive, and management focused. Feed back into formal agricultural S&T is minimal	Some interaction with selected departments or disciplines – mainly on an individual basis, with hardly any formal agreement between industry and public R&D organizations Focus on seed technologies (varieties) and research results that industry can use.
PAs and innovation system features	<p>Interactions are need based & diverse with stakeholders ranging from farmers, input producers, traders, retailers, legal and certification organizations. They facilitate and provide a platform for them to share and learn. They have linkages with other similar organizations in the OAIS. Scientists retired from public sector R&D organizations are the major members of these PAs.</p> <p>Help farmers technological innovations related to production of organic inputs, related training programmes and also location specific packages of practices.</p> <p>Institutional innovations were in</p>	<p>Interactions are not very diverse and very specific, they mostly form a link between the public sectors organizations (earlier the only source of breeder seeds) and private sectors seed companies to help them get this resource material for multiplication and sale to the farmers. Scientists employed in private seed companies are the major members of these PAs.</p> <p>More technology focused and concentrates on bringing more hybrid seeds into the market. Institutional and issues addressed are national level issues, like seed policy that helps the seed industry.</p>

<p><i>Evidence of learning and behavioral changes</i></p> <p><i>Creating or enabling policy and institutional environment</i></p>	<p>response to the certification cost and other impediments faced by the small farmers related to organic production</p> <p>More of field work than before, speak to and learn from farmers, more number of and frequency of interactions with non-farm and non-research actors, looking for new funding sources, concerned about local specification and control, therefore fear expansion.</p> <p>By raising awareness about OA among the public, pushing OA policies and environmental issues into the agricultural policy of the States, Facilitating certification processes, Capacity building programmes in OA</p>	<p>Not much, they have resorted to rent seeking behaviour</p> <p>Recognize the need for collective professional voice in the industry</p> <p>Gradual reduction in interaction with public R&D and increasing investments in private seed company R&D</p> <p>Help push and voice based policies that favor seed business.</p>
<p>Common features/constraints</p>	<p>Both have funding difficulties</p> <p>Need support to articulate necessary policy changes</p> <p>Lack of professional staff</p> <p>PAs work as service provider</p> <p>Disconnect with the research system</p> <p>Disconnect with formal R&D based PAs</p>	

Source: Author's analysis.

PAs in HSIS are old and well established along and were formed in response to the ongoing drive for green revolution packages of technologies (HYV +Water +fertilizers) with hybrid seeds as one of the essential components, while other components, water and fertilizers conform to the need of the hybrid seeds. They were formed to cater to the growing needs of the hybrid seeds while making use of the relaxed policy environment in the country.

PAs in OAIS initiated as an alternative to the conventional agriculture, for a more sustainable way of agriculture for small farmers. However, the real boost for the sector came in for its increasing scope for export. So the PAs associated with the sector are also new, learning and growing up and are at different stages of evolution. PAs are different because of these inherent differences in the nature of the two innovation systems and their contexts (Table 5). These differences also underlines the point that these actors (PAs) are embedded in an institutional context that determine how they behave individually and how they interact with other actors of their respective innovation systems (Hall, 2003). A comparative analysis of the two cases highlights differences in the evolution of these agricultural innovations and identifies potential differences. This will help derive lessons on what drives innovation and generic interventions that promote the capacity to innovate. This intervention would help strengthen innovation capacity and help arrangements evolve towards a dynamic, responsive and sustainable system (IBRD, 2006).

8. Conclusions

Innovation systems framework is now increasingly being applied to developing country issues in agriculture and the rural sector. This framework recognizes that innovations emerge from systems of actors. This study explored the innovation system roles and capacities of one of the important actors in AISs i.e. Professional Associations of scientists or science-based actors. This group of actors 'Professional Associations', which forms an important linkage between knowledge generation actors and utilization actors, are generally ignored in the innovation systems literature. It explored PAs in two innovation systems in the agriculture sector - one fairly well established (the HSIS) and one relatively new and emerging (the OAIS).

The study proved its hypothesis, viz., the fact that PAs do play an important role in agricultural innovation. It did so by demonstrating and analyzing how the PAs play a role in improving the capacity and inter-linkages among actors (organizations and individuals) in both the Hybrid Seeds and Organic Agriculture sectors. The PAs draw from the established fields of science that they have expertise in and use this expertise to inform and enable growth of the HS sector and OA sector. The purpose of this analysis is to acknowledge and promote the role of the PAs as actors in innovation systems, which enable the agricultural sciences to interact pro-actively with other actors in the society and lead to technological and institutional changes (Raina, Sangar, Sulaiman and Hall, 2006). This study identifies specific strategies that these PAs have used to enable innovation in and development of their respective sub-sectors – HS and OA. Given the scientific legitimacy that these PAs carry and their capacity to influence and shape innovation in their respective sub-sectors, the question now, is whether it is possible to engage with PAs as a catalytic agency or actor for the establishment and sustainability of other agricultural innovation systems. Another major question is how the PAs can be strengthened to reinforce and revitalize formal agricultural R&D?

8.1. Findings and lessons drawn

The major findings that confirm the role of PAs in enabling agricultural innovation are:

- (i) ***PAs are important actors in bringing together other socially embedded actors in both the innovation systems explored.***

PAs, which have largely not found much place in the innovation systems literature, are playing an important role of facilitating communication and interactions among various actors with different technological and social competencies. By doing so, they enable innovation. In these two cases analyzed here, they represent a link between the public sector R&D and private sector as well as the Civil Society Organizations. As actors with scientific expertise and social capital (trust), they help bridge the disconnect between the two- public sector S&T and other actors of relevance in each sub-sector.

(ii) *PAs play an important role in shaping other actors in the Innovation System*

PAs may not be the dominant innovation system actors in the innovation systems but there are very many positive lessons to be learned from some of the institutional changes they have been able to push and introduce in each of the innovation systems. They also bring flexibilities related to funding, human resources or in the ways to organize their working. PAs thus present cases of both technological and institutional changes – the former because of their opportunity to draw from their own scientific expertise, the latter because they find ways of enabling new rules, certification norms, procedures, practices etc. that can help the technology as well as the sector as whole.

(iii) *PAs play an important role to enable learning within the PAs as well as among the actors in the innovation system*

By participating and serving farmers through various State and central training programmes they play a major role in capacity building of farmers. While this is a very obvious learning exercise facilitated by PAs, they enable several other forms of learning. As they are aware about most the similar schemes or programmes in their respective sub-sectors, they facilitate the process by identifying the right kind of persons/NGO's at the local level. With the public sector opening up to alliance with private sector, the PAs in HSIS play an important role in facilitating the right kind of linkages. Similarly in OA, the new NGOs and environmental groups that promote OA, find the PAs a source of information and learning on how to function, whom to contact, how to export, get certification, costs of various certification and phytosanitary requirements, etc. PAs also help in linking up and identifying organizations that can make use of various centrally sponsored schemes to boost private seed sector to help the seed industry. One actor on whom the PAs have had little impact in enabling learning is public sector agricultural R&D. Though scientists interviewed do admit that there are lessons to be learnt from the ways in which PAs promote their own sectors/ industry, they have little opportunity to take up or practice the lessons they learn from the PAs.

(iv) *PAs create an enabling policy and institutional environment for their respective sub-sectors and innovation systems there-in:*

By pushing OA policies into the agricultural policy of the States, facilitating low cost certification processes, capacity building programmes in OAIS and pushing the need of the seed industry and also by changing their own R&D system and demand more and more changes in the rules and regulations of the government to get connected to the global seed market demands. PAs in HSIS are also in the process of merging together to help growth of the seed sector, effective lobbying for specific policies for seed industry reforms and quality market access etc.

Yet, there is little strategic role played by policy making in general, and agricultural policy in particular to acknowledge and promote the role of these PAs in these industries (be it hybrid seed or organic agriculture). All policy effort goes into

strengthening or funding agricultural R&D organizations and extension. Little is done to promote this major actor, the PA, who simultaneously straddles the arenas of science and its applications. Do the PAs lack the legitimacy that formal S&T has, in order to seek and find policy support that can promote their role in shaping innovation?

This study has proven, using the innovation systems features of coming together of multiple actors, combinations of technological and institutional change, continuous learning and presence of enabling policy frameworks, that the PAs are major actors in innovation systems.

Reflecting on these last points (a) about the inability to enabling learning and change within public sector R&D, and (b) about the relative lack of policy or strategic support that enable PAs to conduct their role in innovation, are worth considering in detail. We must ask ourselves the “so what” question. If PAs are important actors or catalysts that can enable innovation, but are still ineffective in enabling learning and change within public sector R&D, it is important to explore why.

The PAs in OA are totally committed to the development of OA on a scientific and organized manner with the help of experienced agricultural scientists, which makes them different from other diverse organizations/actors in the OAIS, and also the legitimacy to bring other actors together in the OA sector. *But they don't seem to be able to push change in S&T organizations*; they continue to be isolated from the research system in the country. Generally coming from the agricultural system they have a good understanding of the various processes as well as technologies that could be put to use potentially to boost the cause of OA. However, they are little connected to the research system and mainly to the R&D based PAs concerned with OA like, the Indian Society of Soil Sciences (ISSS), which was explored (as the PAs within formal agricultural R&D) for the study. Is it because formal agricultural R&D is still tentative about the possible role of organic agriculture in agricultural production, productivity, and growth?

The case of the PAs in HS sector proves otherwise. Similar to the OA case, PAs in HSIS are hardly connected to PAs within formal agricultural R&D like Indian Society for Seed Technology or Indian Society for Plant Breeding and Genetics. This belies the doubt about whether it is the ‘organic’ aspect of the former PA that leads to its isolation from formal agricultural R&D; the formal agricultural R&D organizations do support and legitimize the role of hybrid seeds in agricultural production and productivity. Although the PAs in formal R&D do express their desire to get connected and work with industry, when asked, any efforts in the direction were absent. Among the PAs in formal agricultural R&D, there seems to be an air of satisfaction, in their protected research domains, and a sense of achievement that industry has used their research material at least till the recent past. There is some concern about the fact that almost all the hybrid seed used in India does not use the erstwhile public sector breeders seed, but is free to import any suitable seed or plant material from private or public sources elsewhere. But little effort is made to connect this seed policy change to their own inability to engage with or learn from the hybrid seed industry and its PAs.

9. Recommendations

Public sector agricultural R&D is mainly managed by ICAR and its institutes under Central Ministry of Agriculture, State agricultural universities and Departments of Agriculture or Agricultural extension in their respective State governments in every State of the Indian Union. Public sectors still dominates but with the decline in the funds available to public sector institutions for agricultural research and liberalization of Indian economy in 1990s, and investment in private sector R&D has increased. Private research in India has grown rapidly and faster than public agricultural R&D (Pray *et al.*, 2001). Although private sector share to agricultural research has increased it still occupies very modest proportion in contrast to the vast demand and are often guided by profits and depending exclusively upon it would be counterproductive (Jain, 1999). This brings the need for strengthening public sector R&D which still dominates and which has resented institutional changes despite various external evaluations or several conferences/workshops or research papers (Raina, 1999, Raina *et al.*, 2007). The relative difficulty or unwillingness to reform the institutions is a feature that marks Indian agricultural research and extension organizations (Lele and Goldsmith, 1989, Raina, 2003b).

Science based PAs unlike other organizations of the R&D have a central concern about furthering the interest of the profession and serving the social needs. These PAs can, if supported appropriately, now play a major role in institutional reform in the agricultural sciences. They can orient the agricultural sciences towards the dynamic role that science can play as one of the components in wider innovation systems. These PAs are present but are hardly identified as actors in the R&D System. Public sector have institutionalized these organizations and invested in them and with declining growth and innovative capacities of public sector R&D, it is now time for them to play enhanced role by making them more accountable to the State/Centre or industry.

Based on the analysis, a few recommendations for policy and action by both the State and industry, to enhance the positive role that “PAs” can play in agricultural innovation are:

Table 6. Recommendations for PAs by the State and Industry to strengthen S&T and its relevance.

Innovation system features	Opportunities for the State for strengthening the role of the PAs	Opportunities for the Industry for strengthening the role of the PAs
<i>Presence /interactions of several organizations/actors with bringing of different sources of knowledge and expertise</i>	<ul style="list-style-type: none"> -by making mandatory for the PAs to report the number of diverse linkages made that resulted in bringing technology to use -allowing scientists to share monetary (some percentage) benefits that lead to profits -taking up at least one research problem from the field which is 	<ul style="list-style-type: none"> -number of linkages with PSUs that have helped the seed industry -Making available data on private seed industry available to the public sector -identify scientists with specific need of the industry

	related to the sector - making PAs part as members of the decision making board/meetings related to the sector	
<i>Focus is on both technological as well as institutional change</i>	-bring private funding to get some of public research funded -reporting the changes/ linkages with field level PAs/other actors -increase funds + impose self assessment mechanisms -an independent central body that coordinates/controls/reviews their efforts regularly	-help private sector getting access to resource material and sharing the benefit with public sector or get the private sector fund for research work -funding farmers feed back results /surveys -increase funds + impose self assessment mechanisms - impose regular external evaluations
<i>Evidence of learning and behavioral changes</i>	-capacity building programmes conducted based on farmers/other stakeholders feedback -number of field visits, number of farmers visited and problems they face -promote culture of self evaluation	-number of field visits to get feed back of the products -capacity building programmes for updating -identifying possible technological and institutional changes areas public-private partnerships possible
<i>Creating or enabling policy and institutional environment</i>	-ask the number of policy issues addressed and then resolved -identifying and bringing to policy attention the role played by PAs -initiating support (funding + forums for interaction) within Ministries and Departments (both agricultural and non-agricultural) for PAs	-ask number of favorable policy issues helped resolved -reporting the spurious seeds and help in punishing -number of dispute resolutions solve-reporting inadequacies in the business environment

Interventions are essential for building the capacity and fostering the learning that enable an innovation system respond to the continuous competitive challenges. PAs are positioned well as facilitators to cater to local situations/ needs and getting help through various interventions will help improving innovation capacity of the PAs and their respective innovation systems. Comparison and findings from the exploration of the role of PAs in the two agricultural innovation systems reveals that PAs are important actors in the innovation system but their roles have not changes in the changing context. This change will happen only when their professionalism is recognized in the innovation system. While professionalization of these PAs could be increased by increasing their visibility and recognition by the State, but not compromising with their flexibility and voluntary nature.

End Notes

- ⁱ Codex Alimentarius commission is an intergovernmental body established in 1962, produced a set of guidelines for the organic production (Willer & Yussefi, 2006).
- ⁱⁱ IFOAM was formed in 1972, as an umbrella organization of the organic movements of the world has been taking concrete promotional efforts to bring about socially, Economically and environmentally sustainable development over 100 countries it is operating. This also which gave an international framework for the discussion and codification of internationally recognized principles of organic farming. IFOAM has over the past two decades playing a key role in promoting ecologically sound and socially acceptable agriculture in the India. It is an organization responsible for setting up International standards for organic agriculture, which have been developed on the basis of experience of organic farmers and they incorporate ecological and social values dear to the IFOAM membership. IFOAM accreditation program through its International accreditation Service (IOAS) is playing a significant role by accrediting new certifying bodies in India through its manuals on setting up certification organizations along with several interactive programmes involving data collection, standards development, marketing, certification and lobbying to strengthen the organic movement in India.
- ⁱⁱⁱ In Uttaranchal, the organic agriculture was mainly promoted by UCOB, which also tried to integrate it with well with several rural development projects, emphasizing export as well for domestic market development.
- ^{iv} Formation of the UCOB was possible through personality push/insightful thinking of an experienced bureaucrat (Dr. Tolia), who objected during the board formation to be a State body, which would have deprived the board with the flexibility in rules related to its functions/funding etc. UCOB, served as a major learning organization /a success story for other states like, Andhra Pradesh, Karnataka, Rajasthan, Mizoram, Sikkim etc. Also influenced the formation of various similar organizations/professional associations with organic agriculture as a major motive.
- ^v Ms. Sandipa Kanitkar, MD. personnel communication.
- ^{vi} Certification programmes consists of standards (rule), inspection (checking whether the rules are implemented) and certification (judgment). Only through this programme, OA is distinguished from other methods of sustainable agriculture. Only going through these standards the products could be labeled as “certified organic” and sold commercially as such. Certification in OA is generally done by the independent body often termed as third party certification. This implies that it is not done either by the producer (First party) or the buyer (second party). Certification process has been institutionalized through accreditation certifying agencies and includes farm inspector and audit trials (Checking records). (accredited by APEDA).
- ^{vii} There are 12 certifying agencies as of now accredited by APEDA for certification, these agencies regularly monitored and evaluated by APEDA.
- ^{viii} In order to promote OA, funds have been given to the development of Bio-villages (2004-05), one village in each district is being developed as biovillage, where use of green manuring, biofertilizer/bio-pesticides/bio-agent are promoted by way of organizing demonstration in each village.
- ^{ix} MOA has taken up the technical Cooperation Programme (TCP) of FAO (TCP/IND.#Development of Technical capacity Base for the Promotion of OA in India) to overcome the knowledge gap with respect to Technical Packages of practices for various crops based various ecological Zones in the country)
- ^x For example at the State level, government is allowing sale of biofertilizers of which chemical composition is disclosed, test protocol developed, test report submitted and approved from government, NCOF also checks/analyses the samples picked up by the fertilizer inspectors of the State.
- ^{xii} Role of PAs in science especially in natural resources innovation system has been explored (Raina *et al*, 2006). PAs role in agricultural sciences has also been explored (Sangar & Abrol, 2006).

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Annexure I

Common template for discussion with Professional Associations in Organic Agriculture /Hybrid Seeds Innovation System

- a. What roles they play in the OA/HS sector,
- b. How they play these roles,
- c. With whom (other partners/collaborators),
- d. Is there a regional distribution of their members? – South, North, North-East, etc. or State-wise?
- e. What is the structure they have?
- f. Why did they choose this structure?
- g. How do they choose (elect/handpick/elect among members/elect among graduate members) their office bearers? Because of communication skills, expertise in science/chemistry or any such? Stature in academics/bureaucracy?
- h. When were they established? And what was the need expressed by the OA/HS sector/industry at that point for the PA to come into existence? Or did the PA start first and then promote an OA/HS industry?
- i. What they have learnt, over time? Any documentation? Any example?
- j. What have they learnt from specific actors (organizations/individuals?)
- k. How they have helped others learn etc.
- l. What are the constraints or issues they face ?
- m. What are the other constraints the sector face or tell them about
- n. What do they plan to do about these constraints?
- o. Are there new opportunities emerging in the sector?
- p. How does the PA plan to take advantage of this?
- q. Do they lobby with the government or others? Export houses? Trade blocks (SAFTA /SAARC /ASEAN +3, etc.)?
- r. Do they have their own officers do this or is there an agent/contact in these trade blocks?
- s. Is there anything that they are really proud of – about the OA/HS sector and about the PA?
- t. What is their most significant contribution to OA/HS sector in India?
- u. How do they see the PA evolving over time? – More members? More collaboration? More countries? Wider networks? More expertise?
- v. Are they in touch with any other PA? Which ones – and how to they communicate with them (frequency/purpose/among all members or among office bearers only)

Annexure II

Table: Some of the Key organizations related to Organic Agriculture in India

S.No.	Organizations	Affiliations and key organizational and institutional features
1.	Uttaranchal Organic commodity Board(UCOB)	<p>-Formed in 2003 through personnel push, a State body with main activities/functions to promote Organic farming in the State of Uttaranchal, and to introduce, promote and adopt appropriate technologies for improving production, and to arrange organize and undertake all activities relating to improve organic production of various commodities in the State</p> <p>-It has integration with other allied sectors like horticulture, medicinal & aromatic plants, herbs, milk production, and animal husbandry in the State. Played a crucial role of strengthening organic programs in the line departments of the State.</p> <p>-Centre of Organic Farming (COF) is anchored within the umbrella. Conceptually the centre is an independent entity the administrative functions of the COF are operated from the UOCB administrative unit itself. COF is mainly supported by Sir Ratan tata Trust trust since 2003. Only 15-20% funding of the boards is through State government rest of the funding is Centre for Organic farming to access funds, grants and other finances for the different organic activities. COF, which is largely funded externally, is a source for human resource for the technical and marketing activities. COF is a deemed centre of excellence in the making and is meant to provide technical assistance to those critical areas in the on-going organic initiative of the State of Uttaranchal, which are being presently provided through State departments.) These areas of support are primarily in the form of technical expertise and human resource.</p> <p>-UOCB has been able to popularize the concept not only within the state but also outside specially to the other mountain states. There is a constant visit list of farmers, officers and NGO for learning the Uttarakhand experience. Within the state a number of voluntary organizations have included the organic farming in their programs. Models where in the production to markets (complete supply chain) under the organic systems have been established at several places. The commodities where substantial progress has taken place is in Basmati, Mandua (finger millets), chillies, other spice, wheat, pulses, traditional rice, perishables like vegetables etc. Product Development of mandua (finger millet) as an ingredient in the India Mix, a product for the mid day meal under the ICDS program was done where the use of mandua has been standardized with the World Food Program (WFP) thus creating a market of 1000 metric tons of mandua in the market. Similarly organic products from tribal.</p>

2.	<p>Navdanya started as a program of the Research Foundation for science, Technology and Ecology (RFSTE), Navdanya means nine crops that represent India's collective source of food security.</p>	<p>-A participatory research initiative founded by world-renowned scientist and environmentalist Dr. Vandana Shiva, to provide direction and support to environmental activism. -It plays role at 2 levels: grassroots and other at Advocacy. Is also associated with "Uttaranchal Council of S&T" now it is a State program.</p> <p>- It has its own seed bank and organic farm spread over an acres of 20 acres in Uttaranchal, north India. Navdanya's members include farmers as the producer members and consumers as consumer member, shaping the food system through their consumption choices. To complete the organic chain from seed-to-the-table, Navdanya has started organic outlets and cafeteria and is building a larger network.</p> <p>They have networks with have people at different level and strong and long chain marketing, network, quality control etc. from production to marketing.. Their certification is done through outside agency SCG (private and not government agency like USOCA located in Uttaranchal) located in Gurgaon.</p> <p>-They do not share very pleasant relationship with UCOB, although they were interested to be part of their governing body or associating with them, being a private body they were not allowed. There villages /farmers /certification agencies and other related organization involved are different from UCOB. No linkages to UCOB. This may be due to their comfort zone they seek due to Eminent world known personality, and anti science position, which seeks external organizations rather than local for funding and certification.</p>
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3.	International Competence Centre for Organic Agriculture (ICCOA)	<p>-In 2003, in a planning workshop at National Academy for Agricultural Sciences (NAAS), Delhi, the stakeholders (a number of NGOs, farmer organizations, companies, research institutions and government agencies) agreed on a joint vision and road map for building up the Competence Centre.</p> <p>-Membership is open to individual farmers, farmers' organizations, government organizations, NGOs, corporates, traders, processors, certification agencies, research institutions, and of course consumers and consumer forums</p> <p>-ICCOA's mission is to help build the competence of individuals and organizations of the South Asian region in organic agriculture and thereby contribute to building ecologically, economically and socially sustainable agriculture and organic business. ICCOA has a strategy to grow as an effective interface organization, while remaining lean and efficient. Therefore, it values building Partnerships with national and international institutions and individuals of organic business such as, FiBL, IFOAM, BioFach, National centre of Organic Farming, APEDA, organic farmers, processors, traders etc. ICCOA has an ongoing partnership with FiBL (Research Institute of OA in Switzerland)) for technical collaboration. The two institutions foresee vast scope for a strong partnership in implementing various programs jointly in South Asia region.</p> <p>- organized organic trade fairs since 2005 (in Delhi, they could bring various stakeholders together and lot of trade got done -some 42 crores of trade was generated as per their analysis).</p> <p>-ICCOA have a typical organizational structure of a society with general body of elected members, (registered under societies Act), however they also have other (3) kinds of memberships also with different roles/powers/ fee structure.</p> <p>-ICCOA however based on its consumer surveys (they boost that it is first of its own kind?) presumes that future market for domestic products is on the rise, a latent potential which could be tapped (Rao et al, 2006)</p> <p>-ICCOA is also official IFOAM Organic Service Centre in India (IOSC).One of the major successful event organized since 2005 for brining diverse stakeholders together and bringing lot of trade/partnerships possible has been by organizing India Organic trade Fairs (fro 2005 to 2007).</p> <p>ICCOA was mainly running through foreign funds and few of the organic events organized in India. Now they are gearing up to get funding through projects, they already have an OXFAM project and are also starting to work with the govt. of Arunachal Pradesh. Unlike UCOB they work in collaboration with various partners outside Karnataka.</p>
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4.	Institute of Natural Organic Agriculture (INORA)	<p>INORA is an NGO, registered as Trust established in 1992, by personnel push of Late Prof. M.R.Bhiday ,an eminent Physicist along with Economist Padmashri Dr R T Doshi. Composed of core team of technical experts from, soil fertility management ,and waste land reclamation technology, like Padmadhri Dr R T Doshi. Who was recognized by Govt. Of India. He was awarded Padmashri for his research on use of balanced fertilisers and its economic impact on agriculture. He also patented techniques for Mixed Fertilizers Production and City Farming etc. Into production of Biofertilizers, biopesticides, vermicomposts and liquid manure.</p> <p>-INORA has also been selected by both Central and State government schemes and other projects on Balanced and Integrated use of fertilizers. The organization has close links with NOCA, MOFF, however their field work area is different, they do not directly work together, however they do engage in trainings/ seminars together. They are more concentrated towards development of inputs for organic agriculture, as service provider, training, extension, awareness programs for farmers.</p> <p>-It has been selected by both Central and State Government for a scheme on Balanced & Integrated use of Fertilizer. Under this scheme the institute has conducted training programmes which were attended by 10, 000 farmers, Associated as advisors for Earthworm Biotechnology , Organic farming and Biofertilisers and set up vermicomposting units, conducted training programs for- Watershed Development Directorate, EEC Sponsored Programme, Deharadun, U P., Maikaal Bio - Re , Indore, M.P. This a huge Organic cotton growing farmers association. INORA conducted training programs and set up vermicomposting units. established pilot vermicomposting units for Delhi Development Authority Delhi, etc.</p>
5.	Centre For Indian Knowledge Systems(CIKS)	<p>-CIKS was formed in 1993, as an autonomous centre under the Academy of Development Sciences, Maharashtra. In January 1995 it was registered as an independent trust in Chennai. The activities of the centre are supported through grants from government agencies, private agencies, donations from individuals and the sale of educational and training material.</p> <p>-OA is only one of the major activities that they promote as traditional knowledge, they have also come out with specific packages for organic crops. Based on their work they have come out with lot of publications related to organic farming techniques specific to crops(vegetables, rice, cotton etc.)/composting, why care about organic food and livelihood security through organic way. -It is involved in project on supported by the Ford Foundation, which aims to enhance the livelihood of small and marginal farmers through organic farming and biodiversity conservation. It also gets core support of the Department of Science and Technology, Science and Society division for the last four years.-Another project funded by CAPART(till 2007) for enhancing livelihood security of small and marginal farmers by empowering them with a package of organic and sustainable farming technologies.</p>

6.	Organic Farming Association of India (OFAI)	<p>Started by Environmental activist Claude Alvares, it an organization of grassroot organic farmers, as a source of livelihood for small and marginal farmers its membership reflects that with its members located through out the country institutionalized through, managing committee, National and State steering committees, OFAI State secretariats in states like, Gujarat, Kerala, TamilNadu, Maharashtra. Orissa, Andhra Pradesh, West Bengal), consultants, advisors, technology resource centers etc. They have a labeling scheme to guarantee organically grown produce only for domestic markets. They are also associated with anti-GM campaigns. The organizations raise its funding mainly from membership fees, payment charges from farm appraisal visit, consultancy services, sale of certified organic seeds, sale of publications etc. They mostly work in activists mode at the field level.</p>
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7.	Maharashtra Organic Farming Federation (MOFF)	<p>Maharashtra MOFF, a member farmers organization in Pune, is an organization of individual farmers, work closely with wide range of stakeholders from private, public sectors organizations and institutions. Its work is restricted in Maharashtra State, but farmers from other states visit/undergo training/visit farms to learn lessons related to organic farming associated with specific crops like, sugarcane. The organization is working for sustainable livelihood of resource poor farmers to bring them out of non-profitable practices of chemical farming, which incur heavy losses, and ultimately farmers committing suicides. To strengthen the organic farming movement further, MOFF initiated the concept of “ORGANIC SCHOOLS”. These schools have been established in each Taluka level of the state and successfully imparting the technical knowledge in organic farming practices. These schools are virtual universities for the need based knowledge on the OA has three tire structure, comprising of Advisory committee, Trustees and Apex council members totally one hundred in number, which is think tank of MOFF. They form individual as well as institutional members. Managed by Board members, They arrange Training & Certification programs for farmers, and support farmers to market their organic farming produce.</p> <p>-It is a trust which draws its funding mainly from the membership fees, and sponsored projects from variety of organizations like, FAO (to develop packages of practices four 4 important crops.), ICCOA, Gene Campaign, CEE, NAVDANYA, CCD, Dept of biotechnology, New Delhi, NCOF, OFAI, MITCON, Pune, and various NGOs. They coordinated for the field activities through its district heads (35 organic farmers), and District Coordinators(70 organic farmers). Their other activities included, onfarm organic schools(for which they seek funding), set up organic model farms for specific crops, demonstrations plots for various crops, input production, vermin composting, biofertilizers, bioagents etc., , Trainings related to certification, input production, quality control, trainers training, capacity building of directors etc. facilitating marketing of organic produce, anti gene Campaign, publications, study tours of organic farmers, seed banks, PGS system for organic certification etc. . Besides MOFF was also played important role and successfully completed in Farmers Suicide Prevention Mission in Suicide hit 6 districts of Vidarbha region recently using organic agriculture as a tool.</p> <p>As of now Maharashtra State has no policy for organic farming, however now the initiatives have begun with MOFF member “MAHA organic Policy Committee” Department of Agriculture, Maharashtra State, Mumbai..</p> <p>MOFF also has a member in the “ Empowered technical committee on organic farming, Min of Agriculture and Co-operation (GOI), New Delhi , a MOFF is also a member of organic sub Committee for eleventh 5- year plan of Government of India, New Delhi.</p>
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8.	Institute for Himalyan Mountain Development in Harmony with nature(INHERE)	The Institute of Himalayan Environmental Research and Education (INHERE) has been working since 1982, an NGO working for the holistic development of the mountain people of the Himalayas. It works as a research organization, a support organization and a grassroots implementing agency. Organic farming promotion is one of their ongoing project. To develop and promote sustainable and diversified organic agriculture systems for food security. Eighty-two villages have been certified organic by SKAL international. INHERE works to promote and provide traditional organic seeds. Winrock FTF Program, the ICEF Project the GMED Project and the SAWF Project have been instrumental in guiding and strengthening the Organic Agriculture Programme of INHERE. INHERE has a multi-disciplinary team comprising subject matter specialists, social workers and village animators
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Source: Based on information Brochures/websites of these organizations + interviews with some of the office bearers.

Annexure III

Table : Some of the Key organizations related to Hybrid Seeds in India

Organizations	Affiliations and key organizational & institutional features
Indian Council of Agricultural Research (ICAR)	ICAR(estd. in 1929) principle agency that undertakes plant –breeding in country... with a network of 46 central institutes, 4 national bureaux, 27 national research centers, 10 project directorates, 90 All India coordinated projects in various part of the country.
State Agricultural Universities (SAUs)	SAUs are another major plant breeders, based on land grant college system of the US. The first SAU was established in 1963—(Pant university). Today 26 SAUs in 16 States and one Central Agricultural university to cater to the need of North East situations. With teaching and research they are supposed to contribute to agricultural productivity. They are mainly funded by State Govts. and ICAR for development of State-level varieties and National Level varieties respectively.
National Seeds Corporation Limited (NSC)	<p>-The National Seeds Corporation (NSC) was initiated in 1961 under the ICAR, and later in 1963 it was registered as a limited company in the public sector (A Government of India Undertaking under the control of the Ministry of Agriculture of Government of India.). . Head Office at Delhi, 11 Regional Offices in the state capitals and over 80 area offices located throughout the country, NSC is well placed to take advantage of the best agro climatic conditions for seed production programme to meet any kind of supply needs.</p> <p>-The NSC was established to serve two main objectives: first, to promote the development of a seed industry in India and second to produce and supply the foundation seeds of various crops. It undertakes production, processing and marketing of agricultural seeds. Its product range include cereals, pulses, oilseed, fodder, fibre and vegetable crops.</p> <p>NSC pioneered the development of Indian Seed Industry on scientific lines with its involvement in the formulation of seed certification standards. Its seeds are evaluated for quality standards by independent seed certification agencies besides internal quality checks and laboratory tests in its own ISTA accredited Seed Testing Laboratory.</p> <p>-Corporation has equity participation in the state seeds corporations to enable uniformity of approach in meeting the national aspirations. To meet its business obligations and also to maintain gradient to ensure flow of technological advancements, the corporation maintains a motivated team of educated and experienced staff . Corporation runs regular training courses to refresh the knowledge of seedsmen from India as well as Abroad. It also maintains a Consultancy wing to render services in all the facets of seed development. NSC rendered such services to the state seeds corporations and agricultural universities in the establishment of seed processing plants, stores and seed testing. These corporations engaged principally in production and marketing of seeds of high yielding and hybrid varieties developed by the public sector.</p> <p>These institutions have been involved in the development of more than 2000 varieties since 1960s.</p> <p>-After National seed policy 2002, has institutionalize NSC as the nodal agency for implementing and monitoring various schemes for boosting seed production in private sectors, central sector scheme on assistance for boosting seed production in private sector and amount of subsidy increased from 10 to 25 lakhs.</p>

State Farm Corporation of India (SFCI) 1969	<p>The origin of State Farms Corporation of India Limited (SFCI) goes back to 1956 when first mechanized farm was established in the Thar Desert of Rajasthan with the machinery gifted by erstwhile USSR on the eve of the visit of Marshal Bulganin. In 1969, to manage the affair of these farms, an autonomous organization under the Ministry of Agriculture</p> <p>As on date, SFCI is managing six large mechanized farms situated in 4 states in different agro climatic zones of the Country. The initial idea of setting up these farms was to increase the food production. However, subsequently keeping in view the importance of the seed, when the first National Seed Project came in the country in 1974, the primary object of these farms became the seed production of "HIGH YIELDING VARIETIES ". Encouraged with the success of seed production in the year 1978, SFCI was also assigned the job of FOUNDATION seed production of different crops to meet out its own requirement of foundation seeds for production of CERTIFIED seed as also to cater to foundation seed requirement of State Seeds Corporations and National Seeds Corporation. The main channels for disposal of various seeds produced at the Farms of the Corporation are through State Agriculture Department . World Bank has recognized SFCI as a consultant in the field of farm development in 1975. Since then, we are undertaking consultancy services for the appraisal, scrutiny and preparation of farm development plans.</p>
STATE SEEDS CORPORATION (SSC)	<p>The State Seeds Corporations are chiefly concerned with the production and supply of certified seed, and within the state marketing of certified seed. State Seeds Corporations have been recently established in order to reduce the workload of NSC. These corporations were established in view of the great success of and the impact made by the Tarai Development Corporation (TDC), Pantnagar (established on February 27, 1969) which had gained a virtual strangle hold on the seed market of U.P.almost to the exclusion of NSC. It is hoped that the State Seeds Corporations would be able to function more efficiently and would be able to stimulate a faster growth of the seed industry.¹³ State Seed Corporations (SSC)</p>
STATE SEED CERTIFICATION AGENCIES (SSCA)	<p>The State Seed Certification Agencies (SSCAs) are responsible for seed certification in the concerned states. The SSCAs make field inspections and conduct seed tests required for seed certification. The SSCA's perform the following functions: they screen the applications from seed growers for seed certification and decide on their fitness, they also check and verify the appropriateness of the source seed used for growing the seed crop under certification, they carry out the requisite field inspections, they conduct the seed tests, they certify the seeds found suitable and issue the appropriate tags both for certified and foundation seeds etc...²¹ State Seed Certification Agency, 105 Seed Testing Lab (68 had been notified includes a central seed testing lab) & 36 Breeder Seed Unit (BSU).</p>
STATE SEED CERTIFICATION BOARD: (SSCB)	<p>Each state has a State Seed Certification Board which supervises the activities of its SSCA. Persons involved in seed processing and distribution, including businessmen dealing with production, processing and marketing of seeds, and scientists from agricultural universities, are the members of this board.</p>
CENTRAL SEED CERTIFICATION BOARD (CSCB)	<p>Central Seed Certification Board (CSCB) advises the state governments and their SSCAs on the matters of seed certification; the chairman of this board is nominated by the central government. The members of the board are drawn from among the officials of the different state departments of agriculture, scientists from the agriculture universities, and persons from the seed industry. The board may also appoint committees for specific tasks.</p>

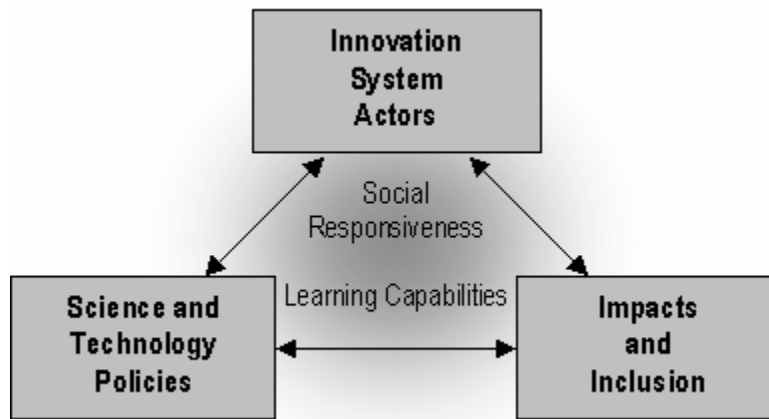
International Agricultural Research system	ICRISAT- At ICRISAT, considerable progress has been made to intro the progress of traits in hybrid seed parent lines and early generation progenies. The private sector's interest in partnering with ICRISAT revolves around hybrid seeds and GM crops. Thirteen seed companies are now involved with the hybrid sorghum programme and 16 with the pearl millet hybrid breeding programme that ICRISAT began in 2000. Companies like Advanta India, Mahyco-Monsanto, Proagro Seeds (Bayer), Syngenta India, Zuari Seeds, JK Agri-Genetics, Monsanto India and Mahindra Hybrid Seeds pay an annual fee of around Rs 2.5 lakh (US\$5,000) per crop to participate in the programme and access the varieties developed. In 2003, ICRISAT launched a hybrid pigeonpea breeding programme with two seed companies,
Private sector companies	Companies with foreign financial and technological collaboration agreements dominate the newly emerging Indian private plant breeder sector. Its participation started in modest way in 1966 with flowers and vegetables, however 1986 is regarded as the started of plant breeding in the private sector with emphasis of Hybrid seed production The private sector comprises of more than 200 organized seed companies include national, multinational and other seed selling companies. In addition to this many other cooperative organization involved in seed multiplication and distribution of certain crop seeds. Indo-American Hybrid Seeds (IAHS) is a pioneer and an innovative Indian seed company. Established in 1964 by Dr. Badrinarayan R. Barwale, Mahyco is a pioneer and leader in the Indian Seed Industry. The company strives to provide quality hybrid seeds. Since its inception it has been engaged in plant genetic research and production of quality hybrid seeds for the farming community of India. Currently, it is engaged in the research, production, processing and marketing of approximately 115 products in 30 crop species including cereals, oilseeds, fibre and vegetables J.K. Agri-Genetics, MAHYCO Ltd., Namdhari seedsd pvt,ltd., -hybrids seeds developed and marketed, india companies MNCs like Monsanto... acquired Cargill seeds in 1998, leading corn and sunflower hybrids, Nunhems seeds Pvt. Ltd. Etc.

Source: Publications/websites related the organizations discussed.

Innovation, Technology and Society (ITS)

Research Themes and Entry Points

Three thematic areas frame both our direct project grants and our partnerships under the ITS program initiative: [Innovation System Actors](#); [Science and Technology Policies](#); and [Impacts and Inclusion](#).



These three entry point themes and their related objectives (see diagram) are not independent. Instead they interact with each other in ways that can help empower developing countries to more effectively harness STI to address their development challenges. The starting point deals with improving understanding of innovation system actor roles and capacities in developing countries. The focus on *explicit* and *implicit* S&T policies helps to frame the enabling policy environment for innovation and innovation systems. Finally, research on impacts and inclusion will address issues related to improving social equity within innovation systems and bring a stronger range of social considerations to bear in STI decision-making.